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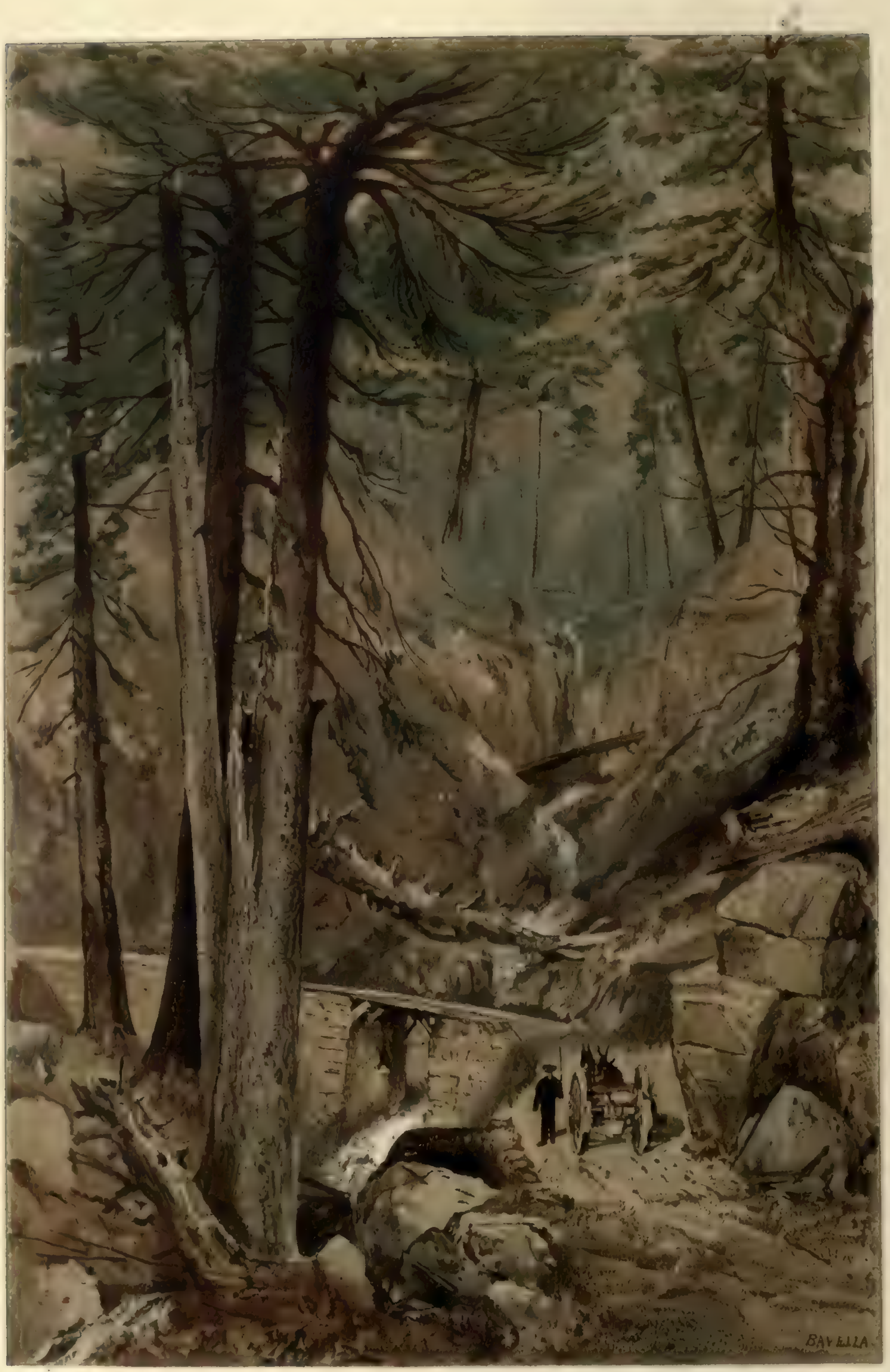
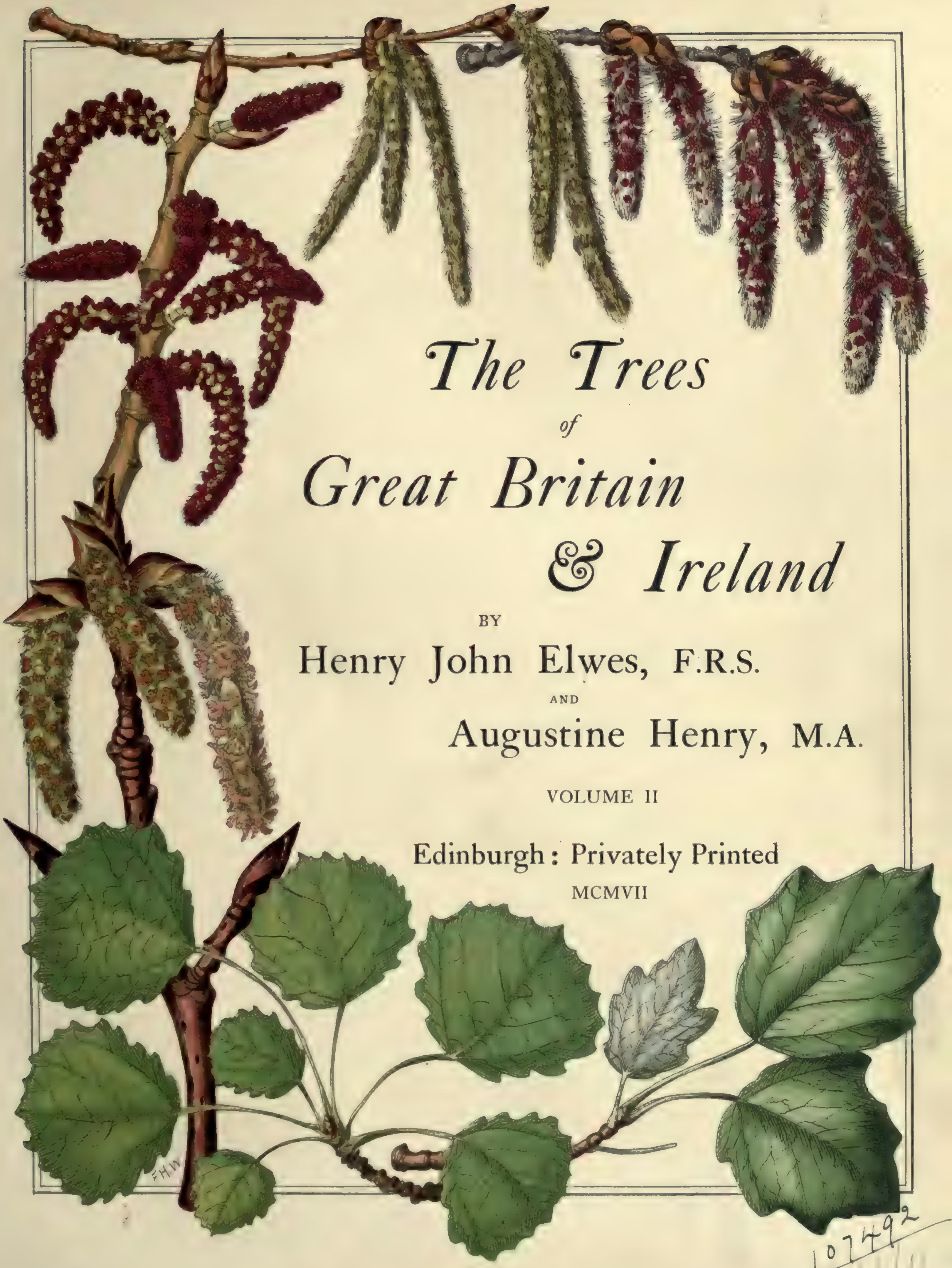


PINUS LARICIO, FOREST OF BAVELLA, CORSICA

From an Original Sketch by the late Robert Elwes.



The Trees
of
Great Britain
& Ireland

BY

Henry John Elwes, F.R.S.

AND

Augustine Henry, M.A.

VOLUME II

Edinburgh: Privately Printed
MCMVII

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1906
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CONTENTS

PAGE

List of Illustrations v

Thujopsis 201

Æsculus 206

Common Horse-Chestnut 210

Red Horse-Chestnut 217

Indian Horse-Chestnut 219

Japanese Horse-Chestnut 221

Ohio Buckeye 223

Sweet Buckeye 224

Californian Buckeye 226

Tsuga 227

Hooker's Hemlock 229

Western Hemlock 234

Hemlock or Hemlock Spruce 239

Carolina Hemlock 243

Himalayan Hemlock 244

Siebold's Hemlock 246

Japanese Hemlock 247

Juglans 249

Common Walnut 251

Black Walnut 262

Butternut 271

Texan Walnut 274

Manchurian Walnut 276

Cordate Walnut 277

	PAGE
NARROW-FRUITED WALNUT	279
SIEBOLD'S WALNUT	280
COMMON OR STALKED-CUPPED OAK	282
SESSILE OR DURMAST OAK	291
PUBESCENT OAK	294
LARIX	345
COMMON LARCH	349
RUSSIAN LARCH	374
SIBERIAN LARCH	379
KURILE LARCH	383
JAPANESE LARCH	384
SIKKIM LARCH	388
CHINESE LARCH	391
TAMARACK	392
WESTERN LARCH	395
LYALL'S LARCH	403
PINUS LARICIO	407
HERZEGOVINIAN PINE	424
GYMNOCLADUS CHINENSIS	427
GYMNOCLADUS CANADENSIS	428
CEDRELA SINENSIS	433
PTEROCARYA	436
PTEROCARYA CAUCASICA	438
PTEROCARYA RHOIFOLIA	442
PTEROCARYA STENOPTERA	443
CLADRASTIS	445
YELLOW-WOOD	446
CLADRASTIS AMURENSIS	449
CLADRASTIS SINENSIS	450

ILLUSTRATIONS

Pinus Laricio, Forest of Bavella, Corsica (from an original sketch by the late Robert Elwes) *Frontispiece*

PLATE NO.

Weeping Beech at Endsleigh 58*a*
Æsculus, leaves 61
Æsculus, twigs and buds 62
Horse-Chestnut at Colesborne 63
Weeping Horse-Chestnut at Dunkeld 64
Æsculus indica at Barton 65
Æsculus turbinata in Japan 66
Hooker's Hemlock at Murthly 67
Western Hemlock at Dropmore 68
Western Hemlock at Murthly 69
Hemlock Spruce at Foxley 70
Hemlock Spruce at Strathfieldsaye 71
Himalayan Hemlock at Boconnoc 72
Juglans, leaves 73
Walnut at Barrington Park 74
Walnut at Gordon Castle 75
Black Walnut at Twickenham 76
Black Walnut at the Mote 77
Quercus, twigs and buds 78
Quercus pedunculata, sessiliflora, and lanuginosa; leaves 79
Cypress Oak at Melbury 80
Self-sown Oaks at Thornbury Castle 81
Champion Oak at Powis Castle 82
Oak at Powis Castle 83
Lady Powis' Oak at Powis Castle 84
Tall Oak at Whitfield 85
Oak at Kyre Park 86
Tall Oaks at Kyre Park 87
Billy Wilkin's Oak at Melbury 88

PLATE No.
Beggar's Oak in Bagot's Park 89
Oaks at Bagot's Park 90
King Oak at Bagot's Park 91
Sessile Oak at Merevale Park 92
Oak at Bourton-on-the-Water 93
Oak at Althorp 94
Major Oak in Sherwood Forest 95
Brown Oak at Rockingham Park 96
Umbrella Oak at Castle Hill 97
Larches in Oakley Park 98
Larches at Sherborne, Gloucestershire 99
Larches at Colesborne 100
Champion Larch at Taymouth 101
Forked Larch at Taymouth 102
Mother Larch at Dunkeld 103
Forked Larch at Gordon Castle 104
Larch in the Alps 105
Dahurian Larch at Woburn 106
Larch in Kurile Islands 107
Japanese Larch at Tortworth 108
Sikkim Larch at Strete Raleigh 109
American Larch at Dropmore 110
Western Larch in Montana 111
Lyall's Larch in Alberta 112
Corsican Pine in Corsica 113
Corsican Pine in Corsica 114
Pinus Laricio on sandhills at Holkham 115
Pinus Laricio at Holkham 116
Pinus Laricio at Arley 117
Crimean Pine at Elveden 118
Pinus leucodermis in Bosnia 119
Gymnocladus canadensis 120
Pterocarya caucasica at Melbury 121
Pterocarya caucasica at Claremont 122
Pterocarya caucasica at Cambridge 123
Yellow-Wood at Syon 124
Pterocarya, Gymnocladus, Cladrastis, and Cedrela ; leaves 125
Liriodendron, Cedrela, Ailanthus Cladrastis, and Corylus ; twigs and buds . . . 126

THUJOPSIS

Thujopsis, Siebold et Zuccarini, *Fl. Jap.* ii. 32 (1842).
Thuya, Bentham et Hooker, *Gen. Pl.* iii. 427 (1880).
Cupressus, Masters, *Journ. Linn. Soc.* (*Bot.*), xxx. 19 (1893) and xxxi. 363 (1896).

THIS genus is considered by many authorities to be merely a section of Cupressus or of Thuya. The foliage and cones, however, are remarkably distinct, and justify its retention as a separate genus.

Evergreen trees, belonging to the tribe Cupressineæ of the order Coniferæ, with reddish bark scaling off in longitudinal shreds. Branches in false whorls or scattered, giving off secondary branches, which terminate in very flattened branch-systems, disposed in horizontal planes. These resemble in their general arrangement those of Thuya and Chamæcyparis, and are mostly tripinnate, all the axes being covered with small coriaceous leaves, adnate in part of their length, and arranged in four ranks in decussate pairs. The leaves on the main and ultimate axes differ only in size.

The ventral and dorsal leaves are flattened and ovate or spathulate, with rounded apices; the lateral leaves are carinate, more or less spreading, with a slightly acute apex, which is bent inwards. The dorsal flat leaves are shining green, and marked with a central ridge, which is often hollowed in the middle line. The ventral flat leaves have a central green ridge, with a concavity white with stomata on each side. The lateral leaves, green on the dorsal side, exhibit a single stomatic concavity on their ventral side.

Flowers monœcious, solitary, and terminal, the male and female flowers borne on separate lateral branchlets as in Thuya. Male flowers cylindric, ¼ inch long, with six decussate pairs of stamens. Female flowers with five ovules on each scale. Cones globular, almost erect, with eight clavate, woody scales, in decussate pairs from a central axis, the upper pair abortive. Seeds three to five on a scale, laterally winged, the wing not notched at the summit.

The seedling[1] resembles that of *Thuya plicata*, but has broader and very blunt cotyledons, with shorter and broader primary leaves.

---

[1] See Tubeuf, *Samen, Früchte, u. Keimlinge*, 103, fig. 143 (1891).

THUJOPSIS DOLABRATA

Thujopsis dolabrata, Siebold et Zuccarini, *Fl. Jap.* ii. 34, tt. 119, 120 (1842); Franchet et Savatier, *Enum. Pl. Jap.* i. 469 (1875); Shirasawa, *Icon. Essences Forest. Jap.*, text 27, t. xi. 18-34 (1900).

Thuya dolabrata, Linnæus, *Suppl. Pl. System*, 420 (1781); Masters, *Jour. Linn. Soc.* (*Bot.*), xviii. 486 (1881), and *Gard. Chron.* xviii. 556, fig. 95 (1882); Kent, in Veitch's *Man. Conif.* 236 (1900).

The species has been described in detail above.

Two well-marked geographical forms occur, both confined to the main island of Japan:—

1. Var. *australis* (*var. nova*). A small tree 40 to 50 feet in height, or a shrub growing as underwood in the dense shade of forests. As a tree it has a slender trunk, with drooping branches and a narrow pyramidal top. Branchlets very flat and only slightly overlapping, the lateral leaves ending in acute points bent inwards. Cones broadly ovoid, with scales thickened at the apex, which is prolonged externally into a blunt triangular process. This is the form which is known in cultivation in Europe, and described and figured in the works cited above.

2. Var. *Hondai*, Makino.[1] A larger tree, attaining 100 feet in height, with a stem of over 3 feet in diameter. The branch-systems are more densely ramified, the branchlets being placed close together and overlapping one another by their edges more than is the case in the preceding variety. The leaves also are smaller, whiter underneath, and crowded more closely on the shoots; those of the lateral ranks being usually blunt and not curved inwards at the apex. The cones are globular, with scales not thickened at the apex, which is devoid of the process so conspicuous in the other form, or merely shows it as an obsolete transverse minute mucro. The seeds appear to be more broadly winged, the wings being more scarious in texture.

This form has not yet been introduced. Elwes has brought home excellent specimens of it in fruit from the Uchimappe Forest, near Aomori, in the extreme north of Hondo. These differ in the characters given above from specimens of the ordinary form obtained by him in the forest of Atera, Kisogawa, and Yumoto (4000 to 5000 feet altitude) in Central Hondo. The smaller leaves, set more closely on densely ramified branchlets in this variety, may be due to the influence of dense shade. The difference in the cone is paralleled by what occurs in the fruit of the different geographical forms of *Cryptomera japonica*. I am inclined to think that var. *Hondai* is not a distinct species; but as it is very different, from the point of view of cultivators, it may conveniently bear the name *Thujopsis Hondai*.

---

[1] *Tokyo Botanical Magazine*, 1901, xv. 104.

Several horticultural varieties have been introduced, viz. :—

3. Var. *lætevirens*, Masters, *Jour. Linn. Soc.* (*Bot.*), xviii. 486.

Thujopsis lætevirens, Lindley, *Gard. Chron.* 1862, p. 428.
Thoujopsis dolabrata nana, Gordon, *Pinetum*, ed. 2, p. 399.

A dwarf shrub having no definite leader, with slender and much-ramified branchlets, and very small and bright green leaves. This variety often shows acicular leaves, spreading all round the shoot, and is apparently a fixed seedling form. It was introduced in 1861 from Japan by J. Gould Veitch.

4. Var. *variegata*. This only differs from the ordinary cultivated form in having the tips of many of the branchlets pale yellow or cream colour. It was introduced by Fortune in 1861.

DISTRIBUTION

Thujopsis dolabrata was discovered by Kaempfer,[1] who mentions it in his *Amœnitates Exoticæ*, p. 884, as "a kind of Finoki." His specimen is still preserved in the Natural History Museum at South Kensington, and was figured by Lambert[2] in his account of the species. Thunberg long afterwards (about 1776) sent specimens to Linnæus, who first gave a scientific description of the tree. Thunberg[3] cites the locality as follows :—"*Crescit in regionibus Oygawæ et Fakoniæ, inter Miaco et Iedo.*" (A. H.)

Thujopsis dolabrata in Japan is known under the name of *Hiba*, and is found in a wild state north of about lat. 35°, and in the southern part of this area is a mountain tree only, occurring in the forest of the Kisogawa district from about 3000 to 5000 feet. In the vicinity of Nikko it is common between about 4000 and 6000 feet according to Sargent, but I only saw it here near Lake Yumoto where it did not appear to attain such large dimensions as farther north. The variety found in the forests of Atera is distinct in its fruit from the northern form. The excellent figure on Plate xi. in Shirasawa's *Essences Forestières* appears to be taken from the southern variety.

The northern form has been described by Makino as var. *Hondai*, but the latter is not mentioned either by Goto or Shirasawa, nor is it recognised as specifically distinct in any of the Japanese collections which I saw. Though the tree usually occurs in mixture with Tsuga at Nikko, and with Sciadopitys at Atera, yet in the extreme north of Japan, on the hills north of Aomori, it is found in pure forest on hills of volcanic formation from near sea-level up to about 3000 feet. An excellent account of the forest of Uchimappe is given in *Forestry and Forest-Products of Japan*, where it is stated that the mountains are of Tertiary formation, and the under-lying rock composed of tufa, sandstone, and slate. Pieces of this rock which I brought home have been examined by Mr. Prior of the British Museum of Natural History, who considers that in all probability they represent a rather basic andesite or basalt, but owing to the weathered and decomposed state of the specimens, satisfactory sections could not be made. I visited this forest in the

[1] See Salisbury, *Jour. Science and Arts*, 1817, ii. 313.

[2] *Genus Pinus*, ed. 2, ii. tab. 68 (1842).

[3] *Flora Japonica*, 266 (1784), sub *Thuya dolabrata*, Linn.

company of Mr. Shirasawa in June, and after passing through the flat rice-fields which extend from the sea to the foot of the hills, entered the forest, which consists mainly of Thujopsis naturally reproduced, though here and there, trees of *Quercus glandulifera*, *Magnolia hypoleuca*, and other species occur, whilst Cryptomeria and *Cupressus obtusa* are planted in the valleys, and *Larix leptolepis* on those parts of the hills where the natural forest has been destroyed by fire. From observations taken at the meteorological observatory of Aomori, it appears that the climate of this part of Japan is cold in winter and the snowfall heavy, the thermometer falling in February to – 15° Centigrade, and rising in September to 32·5° Centigrade; the average temperature for the whole year being 9°, and the average moisture 78 per cent. The average height of the trees here is about 70 to 80 feet, attaining in deep shady valleys 100 feet or perhaps more, and about 2 feet in diameter when closely grown, at the age of 150 to 180 years when it is considered ripe for felling.

The stems are often much curved at the butt from the pressure of the snow on the young seedlings, which require eight to ten years to get above its surface in winter, and these butts are usually cut separately and used for special purposes. The tree does not seem to have the power of reproducing itself from the stool, but produces abundant seed, which in dense shade germinates freely, though the growth of the seedlings is very slow at first.

The undergrowth of the forest is very different from what I saw in other parts of Japan, bamboo-grass (*Arundinaria Veitchii*) being much less prevalent, but in the damp places tall herbaceous plants were numerous, with Aucuba, Skimmia, and Ilex, and other evergreen shrubs on the drier ground, and many pretty liliaceous plants and orchids in places.

Goto says of this tree,[1] that it formed under the old regime, together with *Cupressus pisifera*, *C. obtusa*, *Thuya japonica*, and *Sciadopitys*, the so-called "Goboku" or Five Trees, which enjoyed careful protection at the hands of the feudal authorities; he also says that it is rarely planted, being regenerated naturally by seed, and that it forms extensive forests in a mixture with other conifers such as *Thuya japonica* and *Pinus parviflora*, in the mountains on the northern frontier of the province of Rikuchu, in Goyosan, and in the mountains of the Tone districts, Kozuké. It has lately come to be in great demand for railway sleepers.

Plate 60 (in Vol. I.) represents a dense growth of trees of this species in the forest of Uchimappe very similar to what I saw in the Kisogawa district at about 3000 feet. I am indebted to the Japanese Forest Department for the negative from which it was made.

The wood of Thujopsis is highly valued in those parts of Japan where it grows, on account of its great durability. This is proved by specimens shown at the St. Louis Exhibition, one of which had been used as a gate-post for eighty-three years, another as a plank in a fishing-boat for eighty-four years, others as railway sleepers in use for fourteen years. The wood has an aromatic smell, takes a fine lustrous polish when planed, and is yellowish white in colour, showing a fine grain, which makes selected planks from the butt length very ornamental. Exceptional cases occur in which the wood is curiously mottled and freckled. A ceiling and a screen made of such wood, which I saw in the Forestry Bureau at Aomori, were very beautiful.

---

[1] *Forestry of Japan*, 18 (1900).

The wood weighs about 30 lbs. per cubic foot, and is worth at Aomori from 40 to 50 yen per 100 cubic feet, or about 1s. per cubic foot. It is much valued not only for joinery and building purposes, but for foundations, ship and boat building, as it is stronger and more resinous than other woods of the same character.

The bark also, which is thin, tough, and durable, is much used for roofing and for partitions and walls of out-houses, fences, etc.

Cultivation

T. Lobb sent a plant from the Botanical Garden at Buitenzorg in Java, to Exeter in 1853, which died; and soon after, Capt. Fortescue, a cousin of Earl Fortescue, brought a plant from Japan which was planted at Castlehill in 1859. But this tree, as I learn from Mr. Pearson, the head gardener, has been dead for some time, though plants raised from its cuttings are still growing at Castlehill and elsewhere.

In 1861 Mr. J. G. Veitch and R. Fortune sent seeds from Japan to the Chelsea and Ascot Nurseries, from which plants were raised and generally distributed, so that the tree is now common in England.

From what I have said of its habitat in Japan it is clear that though this tree is hardy as regards frost in winter, it requires conditions which are rarely found in England to bring it to any size, and, as a matter of fact, it has not yet become a tree anywhere except in Devonshire and Cornwall, though perhaps if seeds from North Japan are obtained the results might be better.

Though no doubt it has ripened seeds elsewhere, I have never obtained any which germinated, except from a tree planted about 1881 by Queen Alexandra in the Earl of Northbrook's grounds at Stratton Park, Hants, which I gathered in October 1900. One of these grew, and is now a healthy plant about 9 inches high. It seems to suffer less from spring frost than many Japanese and Himalayan conifers.

The finest tree that I have seen in England is at Killerton, which in 1902 measured 35 feet 6 inches in height and 2 feet 4 inches in girth. It is growing on a slope facing south-west in a peculiar soil, which Sir C. T. D. Acland describes as "Trap, soft below the surface, but hard after exposure. This trap overlies red sandstone, but is rather darker and more porous." This soil evidently suits most conifers admirably, as I have seen no other collection which contains so many fine specimens as this.

At Boconnoc, at Carclew, and at other places in Cornwall there are trees approaching this in height, but we have not seen any specimen above 15 to 20 feet in other parts of England, though as a bushy shrub 12 feet high it exists in most modern gardens. In Scotland it seems hardy in the west and in Perthshire, whilst at Castlewellan in Ireland it has attained 30 feet in height. At Powerscourt and Kilmacurragh, Wicklow, there are trees with the lower branches layering and forming numerous independent stems. (H. J. E.)

ÆSCULUS

Æsculus, Linnæus, *Gen. Pl.* 109 (1737); Bentham et Hooker, *Gen. Pl.* i. 398 (1862).
Pavia, Boerhave, *ex* Miller, *Gard. Dict.* ed. 6 (1752).

Deciduous trees and shrubs, belonging to the natural order Sapindaceæ, some authorities, however, making the genus the type of a distinct order Hippocastaneæ. Leaves in opposite decussate pairs, without stipules, stalked, digitately compound; leaflets five to nine, serrate in margin, pinnately veined. Branchlets stout, terete, with large triangular leaf-scars. Buds large, of numerous decussately opposite scales which are homologous with leaf-bases, the outer deciduous, dry or resinous, the inner accrescent and often brightly coloured.

Flowers in large terminal racemes or panicles, appearing later than the leaves, of two kinds, hermaphrodite and staminate, on the same plant; placed in the axils of minute caducous bracts on stout jointed pedicels. Calyx imbricate in bud, five- or two-lobed, the lobes unequal, united with an hypogynous annular disc in the hermaphrodite flowers. Petals four to five, imbricate in bud, alternate with the calyx lobes and inserted on the disc. Stamens five to eight, usually seven, inserted on the inner margin of the disc, unequal in length; filaments filiform; anthers two-celled, sometimes glandular at the apex. Ovary three-celled, rudimentary in the staminate flowers, each cell containing two ovules. Style slender, elongated, generally curved. Fruit a capsule; prickly, roughened, or smooth; coriaceous; three-celled, three-seeded, and three-valved, or by abortion one- to two-celled and one- to two-seeded, the remains of the abortive cells and seeds usually remaining visible. Seeds without albumen, rounded or flattened by mutual pressure; seed-coat brown and coriaceous, marked by a large whitish hilum. Cotyledons thick and fleshy, unequal, cohering together by their contiguous faces, remaining in the seed-coat during germination.

About twelve species of Æsculus[1] are known to occur in the wild state. They are natives of North America, Europe, and Asia. The genus was formerly divided into two sections, *Pavia*, with smooth fruit, and *Hippocastanum*, with spiny fruit; but this division is not a natural one. The following synopsis groups the species under sections, which are more natural, being dependent on the characters of the flowers and buds:—

I. Hippocastanum. Buds viscid. Calyx irregularly campanulate, four- to five-lobed. Petals four or five, claws not longer than the calyx; stamens exserted. This section includes all the old-world species.

---

[1] The two Mexican species, which have tri-foliolate leaves, are now separated as a distinct genus, *Billia*.

1. *Æsculus Hippocastanum*, Linnæus. Greece.

2. *Æsculus indica*, Colebrooke. Afghanistan, north-western Himalaya.

3. *Æsculus punduana*, Wallich, *List* 1189 (1828). Sikkim, western Duars, Khasia Hills, Upper Burma, Tenasserim, Siam, Tonking. Large tree. Leaflets six to seven, very large, thinly coriaceous, stalked, acuminate, serrate. Panicles 12 to 15 inches or more, flowers white or yellow. Fruit brown, smooth.

Not introduced and not likely to be hardy.

4. *Æsculus chinensis*, Bunge, *Enum. Pl. Chin. Bor.* 10 (1835). Northern and Central China. A tree, 40 to 50 feet high. Leaflets five to seven, large, stalked, obovate-oblong, rounded at the base, abruptly acuminate at the apex, finely serrate, shining above, glabrescent below except for pubescence along the nerves, petioles pubescent. Panicles, 8 inches long, pubescent. Flowers small, white; sepals shortly and unequally five-lobed, pubescent. Petals four, minute. Filaments glabrous. Fruit[1] pear-shaped or globular, small (¾ inch diameter), one-celled, three-valved, brown, covered with warts, not spiny.

This species has been much confused with the next, from which it differs in every way. The flowers, though small, are numerous in the large panicle, and the foliage is very handsome. It is common enough in the mountains of central China, in Shansi, and in the hills to the west of Peking; and when introduced is likely to prove hardy in England.

5. *Æsculus turbinata*, Blume. Japan.

II. Pavia. Buds not resinous. Calyx tubular, five-toothed. Petals four, yellow or scarlet.

6. *Æsculus glabra*, Willdenow. North America.

7. *Æsculus octandra*, Marshall. North America.

8. *Æsculus Pavia*, Linnæus, *Sp. Pl.* 344 (1753); *Bot. Reg.* t. 993 (1826). Middle United States. A shrub. Leaves with slender grooved petioles, the edges of the grooves jagged. Leaflets five, obovate, acute at the base, acuminate at the apex, finely serrate without cilia, slightly pubescent beneath. Flowers in loose panicles, 4 to 7 inches long. Petals red, meeting at the tips; upper pair longer, with claws about three times as long as the small spathulate limb; lateral pair shorter, with claws as long as the calyx, and rounded limb equalling the claw in length; margin of petals beset with minute dark glands. Stamens as long as the upper pair of petals. Fruit brown, without spines.

This species, though only a shrub, is mentioned here at some length, as it closely resembles *Æsculus octandra*, and moreover enters into such important hybrids as *Æsculus carnea*, *versicolor*, etc. All its hybrids may be recognised by the red colour of the flowers and the glandular margin of the petals. It is readily distinguished from *Æsculus octandra* by its smaller leaves and peculiar petioles. In winter it shows the following characters:—Twigs slender, glabrous, shining, with numerous lenticels.

---

[1] Cf. Hance in *Journ. Bot.* viii. 312 (1870).

Leaf-scars obovate or crescentic on slightly prominent cushions, with three groups of bundle-dots; opposite scars joined by a linear ridge. Terminal buds long oval or fusiform, pointed; scales numerous, the upper rounded, the lower pointed at the apex and keeled on the back, minutely ciliate in margin. Pith wide, circular, green.

9. *Æsculus austrina*, Small, *Bull. Torrey Bot. Club*, 1901, xxviii. 359; Sargent, *Man. Trees N. America*, 647 (1905); *Æsculus Pavia, β discolor*, Torrey and Gray, *Fl. N. Amer.* i. 252 (1838), in part. A small tree, attaining 30 feet in height, occurring in Tennessee, S. Missouri, E. Texas, and north-western Alabama. This resembles the last species. The leaflets, however, are usually more irregularly but finely serrate, and pale tomentose beneath. Panicles pubescent, 6 to 8 inches long. Petals bright red, meeting at the tips, unequal, oblong-obovate, rounded at the apex, glandular, those of the upper pair about half as wide as those of the lateral pair, with claws much longer than the calyx. Stamens longer than the petals. Fruit brown, slightly pitted. Not introduced.

III. MACROTHYRSUS. Buds not viscid. Calyx five-toothed. Petals four to five, white, claws longer than the calyx. Stamens exserted, very long.

10. *Æsculus parviflora*, Walter, *Flora Caroliniana*, 128 (1788). South-eastern North America. A shrub. Leaflets five to seven, elliptical or oblong-ovate, densely grey-tomentose beneath, finely serrate. Panicles erect, 8 to 10 inches long, slender, narrow. Flowers white, faintly tinged with pink. The long and thread-like stamens are pinkish white and very conspicuous.

This is a valuable shrub, as it flowers late, in July or August, some five or six weeks later than any of the other species except *californica*. Occasionally it forms a short single trunk, but generally it sends up a crowd of stems from the ground. It is figured in *Gard. Chron.* 1877, viii. fig. 129; and is often known in gardens as *Pavia macrostachya*, Loiseleur, or *Æsculus macrostachya*, Michaux. See *Bot. Mag.* t. 2118 (1820), where it is stated that the species was introduced by Mr. John Fraser in 1785. Canon Ellacombe reported in 1877[1] that he had at Bitton a specimen, which was at least forty years old, but that it remained a bush, not exceeding 8 or 10 feet in height.

IV. CALOTHYRSUS. Buds viscid. Calyx two-lipped or five-lobed. Petals four, pink or white, claws not longer than the calyx. Stamens exserted.

11. *Æsculus californica*, Nuttall. California.

12. *Æsculus Parryi*, A. Gray, *Proc. Amer. Acad.* xvii. 200 (1881); Sargent, *Garden and Forest*, 1890, p. 356, fig. 47. Lower California. A small shrub, resembling the preceding species; but differing in the five-lobed calyx, and in the leaflets, which are small, obovate and hoary pubescent beneath. It has not been introduced.

V. HYBRIDS. The most important is *Æsculus carnea*, Hayne, which is a cross between the common horse-chestnut and *A. Pavia*. This is described fully below.

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[1] *Gard. Chron.* 1877, viii. 691.

Æsculus plantierensis, André, a supposed hybrid between *Æsculus carnea* and *Æsculus Hippocastanum*, will be mentioned under the former species. *Æsculus versicolor*, Dippel, a hybrid between *Æsculus Pavia* and *Æsculus octandra*, will be treated under the latter species.

The following key to the species in cultivation is based on the characters of the leaves and buds. In Plate 61 the leaves of all these species are shown; and in Plate 62 are represented the twigs and buds of six species, *viz.*, *Hippocastanum*, *carnea*, *indica*, *glabra*, *octandra*, and *californica*:—

A. *Leaflets sessile or nearly so*; *buds very viscid.*

1. *Æsculus Hippocastanum.*
   Petioles glabrescent. Leaflets obtusely and irregularly serrate.
2. *Æsculus turbinata.*
   Petioles pubescent, especially towards their tips. Leaflets regularly and crenately serrate.

B. *Leaflets stalked.*

**Buds viscid.*

3. *Æsculus indica.*
   Leaflets finely and sharply serrate, pale beneath. Buds very viscid.
4. *Æsculus carnea.*
   Leaflets obtusely and irregularly serrate. Buds only slightly viscid, the brown scales having a dark-coloured margin.
5. *Æsculus californica.*
   Leaflets shallowly and crenately serrate, pale beneath. Buds viscid, glistening with white resin.

** *Buds not viscid.*

6. *Æsculus parviflora.*
   Leaflets densely grey-tomentose beneath, finely serrate in margin. Buds minutely pubescent.
7. *Æsculus octandra.*
   Leaflets pubescent beneath, broadly lanceolate, shortly acuminate, with twenty or more pairs of nerves in the terminal leaflet; margin finely serrate but not usually ciliate. Petioles without jagged marginal ridges.
8. *Æsculus glabra.*
   Leaflets glabrous beneath, except for a slight pubescence along the midrib and tufts in the axils, long-acuminate, with about fifteen pairs of nerves in the terminal leaflet, finely serrate with ciliate tufts in the bases of the serrations. Petioles with smooth marginal ridges.
9. *Æsculus Pavia.*
   Leaflets slightly pubescent beneath, narrowly lanceolate, finely serrate but not ciliate in margin. Petioles flattened on the upper side, with marginal sharp ridges, usually jagged.

ÆSCULUS HIPPOCASTANUM, Common Horse-Chestnut

Æsculus Hippocastanum, Linnæus, *Sp. Pl.* 344 (1753); Loudon, *Arb. et Frut. Brit.* i. 462, iv. 2543 (1838); *Gard. Chron.* 1881, xvi. 556, figs. 103, 104.

A large tree, attaining in England a height of over 100 feet and a girth of 15 or even 20 feet. Bark smooth and dark brown in young trees, becoming greyish and fissured longitudinally in old trees, at the same time scaling off in thin plates. Leaves palmately compound, digitate, on a long stalk widened at its insertion. Leaflets five to seven, sessile, obovate, cuneate at the base, abruptly acuminate at the apex, unequally and coarsely serrate; green above; beneath pale, tomentose at first, but ultimately glabrous, except for small tufts of hairs in the axils of the veins and a few scattered hairs over the surface; middle leaflet the largest, with twenty-four or more pairs of nerves, lower pair smallest; venation pinnate; petiole glabrous. The leaflets as they emerge from the bud are at first erect, but soon bend downwards on their stalks. When nearly full grown they rise up and become horizontal. In autumn they turn yellow or brownish and fall early, each leaflet disarticulating separately from the petiole.

Flowers in large upright pyramidal panicles, the primary branches of which are racemose, the lateral branches cymose. Upper flowers staminate and opening first; lower flowers hermaphrodite. Calyx greenish, five-toothed. Petals four to five, crumpled at the edge, white, with yellow spots at the base, which ultimately become pink. Stamens seven, longer than the petals, the filaments bent down when the flower opens and the stigma protrudes, later moving up on a level with the style. Fruits few on each panicle, large, globular, green, with stout, thick conical spines, three-valved, usually one-seeded, occasionally two- to three-seeded. Seed large, shining-brown, with a broad whitish hilum. Cotyledons two, large, fleshy, distinct below, blended into one mass above.

Seedling[1]

The cotyledons are large and fleshy and remain in the seed, which frequently germinates on the surface of the soil or only slightly buried beneath it. The cotyledons have long petioles ($\frac{3}{4}$-1 inch), which are broad and flattened, with a concavity on their inner surface. The caulicle, very variable in length (1 to 4 inches), is stout, brownish, pubescent, and ends in a stout tap-root, which gives off numerous branching fibres. The young stem is stout, terete, brownish, striated and marked with numerous lenticels, puberulent or glabrous; it has no scale-leaves, differing in this respect from the young stem of the oak. In other respects the germination of the oak and of the horse-chestnut are almost identical. At a varying height above the cotyledons the first pair of true leaves are produced, which are opposite, compound, digitately five-foliolate, and closely resemble the adult foliage except that they are smaller in size. Successive pairs of similar leaves follow on the stem, each pair being placed decussately with reference to the pair immediately below it.

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[1] Cf. Lubbock, *Seedlings*, i. 356 (1892), where it is stated that the seed is carried a considerable height above ground during germination owing to the great length of the caulicle. So far as I have observed, the seed does not change its position during germination.

Abnormal Flowering

The horse-chestnut sometimes produces a second crop of flowers in autumn, which appear in much smaller panicles than those of spring. This is due to the premature fall of the leaves in July or August, usually following an excessively dry season. The buds are stimulated to premature energy and put forth young leaf-shoots, which are terminated by flowers. This phenomenon, which is equivalent to an anticipation of the opening of the buds by several months, as they would normally open in the following spring, is frequently observed in the trees planted in the boulevards of Paris.[1] In the dry season of 1884, a single tree at Kew produced small panicles of flowers in September, after previously shedding nearly all its leaves. In the following year it produced a few panicles of the ordinary size. At Hythe,[2] near Southampton, a horse-chestnut is reported to have bloomed and fruited three times in 1868, once in spring, again after the rain which succeeded the long drought, and a third time in September.

Identification

In summer the common horse-chestnut is unmistakable. The only other species with large sessile leaflets, *Æsculus turbinata*, is easily distinguished by their regular crenate serration. In winter the twigs and buds show the following characters:—Twigs stout, brown, glabrous or minutely pubescent towards the tip; lenticels numerous. The large opposite leaf scars, flat on the twigs with no prominent cushion, are joined by a linear ridge, and vary in shape, the larger being obovate with seven bundle-dots, the smaller semicircular or crescentic with usually only five dots. Buds very viscid, larger than in the other cultivated species; the terminal much exceeding the lateral buds in size, occasionally absent, and replaced by the saddle-shaped scar of the previous year's inflorescence; scales imbricate, the external ones in four vertical ranks, rounded at the apex, glabrous, not ciliate, dark red-brown. The buds contain the next year's shoot in an advanced state of development, flowers being visible in them in October. The scales are morphologically equivalent to leaf-bases. In the interior of the bud, scales are observable with traces of leaf-blades, which gradually pass into the true leaves, visible in the upper part of the bud.

Varieties

1. Var. *flore pleno*, Lemaire, *Illust. Horticole*, 1855, ii. t. 50. A variety with double flowers, the pistil even in some cases becoming petaloid. Mr. A. M.

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[1] See article by Roze, translated in *Gard. Chron.* 1898, xxiii. 228.

[2] *Gard. Chron.* 1868, p. 1116.

Baumann discovered in 1822, near Geneva, a horse-chestnut tree, of which a single branch bore double flowers; and from this branch the variety was propagated at the Bollweiler nursery in Alsace.[1] The flowers last longer than those of the single kind,[2] and no fruits are formed, which renders it useful as a tree in streets, where the fall of fruits is an inconvenience. This variety is very hardy, and resisted well the severe winter of 1879-80 in France.[3]

2. Var. *laciniata* (var. *asplenifolia*, var. *incisa*). Leaflets cut up into narrow lobes. According to Beissner[4] this variety has been in cultivation for over forty years; and a form of it was found by Herr Henkel of Darmstadt, which keeps its foliage much longer than the typical form; but this is not the case in some localities.

3. Var. *crispa*. Leaves short-stalked, with broad leaflets. Tree compact in habit.

4. Var. *pyramidalis*. Upright in habit.

5. Var. *umbraculifera*. Crown densely branched, and globular in outline.

6. Var. *tortuosa*. Branches bent and twisted.

7. Var. *Memmingeri*. Leaves yellowish in colour, looking as if powdered with sulphur.

8. Var. *aureo-variegata*. Leaves variegated with yellow.

Several other varieties of slight interest, which do not seem to be in cultivation in this country, are mentioned by Schelle.[5]

DISTRIBUTION AND HISTORY

The horse-chestnut occurs wild in the mountains of northern Greece. Halácsy,[6] the latest authority, gives many localities in Phthiotis, Eurytania, Thessaly, and Epirus; but states that it is not found wild on Mount Pelion or in Crete. Baldacci,[7] in 1897, found the tree growing wild on almost inaccessible precipices below the lower limit of the coniferous belt near Syrakou in the district of Janina in Albania.

The native country of the tree was long a matter of doubt; but the whole question was satisfactorily elucidated by Heldreich[8] in a paper, from which we extract most of the following account. Linnæus considered the habitat of the tree to be northern Asia, and De Candolle thought that it came from northern India. The tree is, however, not known wild in India, where it is replaced by *Æsculus indica*. Boissier[9] states that it is recorded from Greece by Sibthorp, from Imeritia (Caucasus), by Eichwald, and from Persia by various authors. It is, however, unknown in the wild state in Persia; and Radde[10] mentions it only as a planted tree in the Caucasus. All the evidence goes to show that it is confined to northern Greece and Albania.

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[1] *Rev. Belgique Horticole*, 1854, iv. 216.

[2] See *Garden*, 1890, xxxviii. 601, where some observations are recorded on the periods of flowering of the single and double horse-chestnuts, and of *Æsculus carnea*.

[3] *Rev. Horticole*, 1884, p. 98.

[4] *Mitt. Deut. Dendrol. Gesell.* 1905, pp. 13, 14, and 1906, p. 10.

[5] *Handbuch Laubholz-Benennung*, 321 (1903).

[6] *Consp. Fl. Græcæ*, i. 291 (1900).

[7] *Rivista Collez. Botan. in Albania*, 23 (Florence, 1897).

[8] *Verhand. Bot. Vereins Prov. Brandenburg*, 1879, p. 139. The British Minister at Athens, Sir F. E. H. Elliot, K.C.M.G., who kindly made inquiries, has sent us a letter from Professor Miliarakis of the University of Athens, dated April 2, 1904, which confirms Heldreich's statements.

[9] *Flora Orientalis*, i. 947 (1867).

[10] *Pflanzenverbreitung in Kaukasusländern*, 433, 434 (1899).

Heldreich states that the horse-chestnut was first found wild in Greece by Dr. Hawkins.[1] In his own travels in Greece in 1897 he observed it in many stations, all lying in the lower fir region, between 3000 and 4000 feet altitude, where it grows in shaded moist gulleys, in company with alder, walnut, plane, ash, several oaks, *Ostrya carpinifolia* and *Abies Apollinis*. These stations, situated in remote uninhabited spots, establish the fact that the tree is really wild. Plants introduced into Greece by the Turks are always found in the neighbourhood of towns. Whether the tree was known to the ancient Greeks is doubtful.

The horse-chestnut was first mentioned[2] by the Flemish doctor Quakleben, who was attached to the embassy of Archduke Ferdinand I. at Constantinople,—in a letter to Matthiolus in 1557. The latter received a fruit-bearing branch, and published the first description[3] of the tree as *Castanea equina*, because the fruits were known to the Turks as *At-Kastane* (horse-chestnut), being useful as a drug for horses suffering from broken wind or a cough.

The tree was introduced into western Europe from Constantinople, the first tree being raised by Clusius at Vienna from seeds sent by the Imperial Ambassador, D. Von Ungnad, in 1576. This tree quickly grew, and was mentioned by Clusius[4] in 1601.

The horse-chestnut was introduced into France[5] in 1615 by Bachelier, who brought the seeds from Constantinople. Gerard mentions it in his *Herbal* of 1579, p. 1254, as a tree growing "in Italy and sundry places of the eastern countries"; and in Johnson's edition of this work, published in 1633, the tree was stated to be growing in Tradescant's garden at South Lambeth. It was probably introduced into England about the same time as into France. (A. H.)

CULTIVATION

No tree is easier to raise from seed than the horse-chestnut. Its large fleshy fruit are so little hurt by frost and damp that they germinate freely where they fall, and do not seem to be eaten by mice like acorns and beech-mast.

Seeds which have been exposed all winter germinate more readily in spring than those which have been kept dry, and should be sown early and covered with about two inches of soil.

Though it is advised by French writers that the extremity of the radicle should be pinched off before sowing in order to prevent a strong tap-root from forming, as is done in the case of walnuts and chestnuts, I have not observed that they suffer from removal if this is not done; and if transplanted at one or at latest two years after sowing there are abundance of fibrous roots which make the tree an easy one to move, even when five or six feet high. As the tree is liable to form large side branches, the buds should be rubbed off the stem early in order to form a clean trunk, though it bears pruning well as a young tree.

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[1] Sibthorp et Smith, *Fl. Græcæ Prodromus*, i. 252 (1806). Hawkins' observation has been disputed, as he records it from Pelion, where the tree does not, so far as we know now, occur wild. Orphanides was the first to establish beyond doubt that the tree is indigenous to the mountains of northern Greece. Cf. Grisebach, *Vegetation der Erde*, French ed. i. 521.

[2] Matthiolus, *Epistol. Medicin. Libri Quinque* (Prague, 1561).

[3] Matthiolus, *Comment. in Dioscorid. Mat. Med.* 211 (Venice, 1565).

[4] Clusius, *Rar. Plant. Hist.* 7 (1601).

[5] Tournefort, *Relation d'un Voyage au Levant*, i. 530 (1717).

Though somewhat liable to suffer from cold winds and spring frost, which injure the foliage and flowers, the tree is hardier in this respect than many of our native trees, though coming from a warm southern country.

As regards the chemical nature of the soil it is quite indifferent, for though it grows faster on a good loam and does not come to perfection on sandy soil, it attains a large size on dry, rocky, calcareous soils, and even at an elevation of 800 feet and upwards resists wind better than many trees. I have seldom seen horse-chestnuts blown down, though large heavy branches are often torn off by violent winds.

As an ornamental flowering tree for parks, lawns, and avenues it has no superior, though on account of its branching habit it requires considerable attention in order to form tall shapely trees. Its principal defect is the tendency of the leaves to become brown and ragged early in the autumn, but they fall quickly, and being easily removed make less litter than the leaves of the beech, oak, or sycamore.

The large branches when allowed to rest on the ground in damp situations frequently take root and become naturally layered, the best instance of this that I have seen being at Mottisfont Abbey, Hants.

For town planting, on account of its beautiful flowers and dense shade during the hottest months, the horse-chestnut is perhaps, next to the plane, one of the best trees we have, and does not seem to suffer much from smoke. In parks it is valuable for its fruit, which are so much liked by deer that they are eaten as fast as they fall, and would perhaps be worth collecting for winter food.

The extraordinary hardiness of this southern tree is proved by the fact that it will grow to a large size as far north as Trondhjem in Norway, lat. 63° 26′, a tree figured by Schubeler near this place being 37 feet by 8 feet 9 inches. Another in the Botanic Garden at Christiania, which is considered the largest in Norway, measured in 1861, 16.62 metres by 2.45 metres, and when I saw it in 1903 had increased to no less than 28 metres high by 3 in girth, though it has been exposed to as low a temperature as − 18° to − 20° Réaumur.

As regards the age which the horse-chestnut attains we have few exact records, but it does not seem a very long-lived tree. J. Smith states[1] that an avenue running south-east from the front of Broadlands House, near Romsey, Hants, was planted in 1735; but in 1887 only two trees remained, which were 11 feet and 12 feet 4 inches in girth.

REMARKABLE TREES

There are so many fine trees in almost every part of Great Britain that I need not go into great detail as to their dimensions, but though it is possible that in Bushy Park, or other places near London, taller trees exist, I have only at

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[1] *Trans. Scot. Arb. Soc.* xi. 540 (1887).

Petworth measured one which exceeds in height the group of three which grow near my own house at Colesborne, of which I give an illustration (Plate 63). The height of these as measured in 1902 by Sir Hugh Beevor and myself was 105 feet, and the girth of the largest 11 feet. They grow in a sheltered situation, on damp, cold soil. One of these trees being inclined to split at the base, owing to the great weight and length of one of its principal limbs, was chained up many years ago, and though the iron band which was put round it has become buried in the wood the limb has not broken off.

At Dynevor Castle, Carmarthenshire, the seat of Lord Dynevor, where the park contains a greater number of fine trees than any I have seen in South Wales, there is a very large tree which the Hon. W. Rice measured in 1906 and found to be 109 feet by 17 feet 9 inches. For height and girth combined this seems to be the largest tree in Great Britain.

The tallest tree I have seen is in a grove of beech, chestnut, oak, and silver fir, which grows near the house at Petworth Park, the seat of Lord Leconfield in Sussex, on a deep greensand formation. This tree, though forked at six feet from the ground, has been drawn up to a great height by the trees surrounding it, and though difficult to measure exactly, probably exceeds 115, and may be 120 feet. The two stems are 9 feet 8 inches and 8 feet respectively in girth.

In Bushy Park most of the horse-chestnuts are past their prime; many of the old trees are dead and have been replaced by young ones. The largest, seen in 1906, was growing near the gate; it had a bole of 20 feet giving off four great stems, and measured 100 feet high by 16 feet 5 inches in girth. Another near the pond was 101 feet by 16 feet 1 inch.

At Birchanger Place, near Bishop Stortford, the seat of T. Harrison, Esq., there is one of the largest and finest trees in England, which measures about 80 feet by 20 feet, with a bole about 15 feet high and a spread of 32 yards; a beautiful photograph was taken in 1864 when the tree was in flower, but it is now partially decayed on the north side, and has lost some large branches.

At West Dean Park, Sussex, the seat of W. D. James, Esq., there is a large tree about 70 feet by 16 feet, with branches spreading over an area no less than 36 yards in diameter.

At Hampton Court, Herefordshire, the seat of John Arkwright, Esq., there is a very fine tree growing on deep alluvial soil in the big meadow south of the house. Measured by T. Hogg in 1881[1] it was 93 feet by 16 feet 6 inches. When I saw it in 1905 it had increased about three feet in height and was 18 feet 7 inches in girth, and still handsome and vigorous.

The largest trees I have seen as regards girth and spread of branches are in Ashridge Park, on a bank near the lodge on the Berkhampstead road. The largest of these is about 80 feet high and 20 feet in girth, with extremely wide-spreading branches, and there are several others of 16 to 17 feet girth in the row. These trees are growing on a dry, flinty, calcareous loam.

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[1] *Trans. Scot. Arb. Soc.* ix. p. 151 (1886).

There is a fine tree at Syon, which in 1905 was 93 feet high by 15 feet 4 inches in girth; and at Broom House, Fulham, there is a tree 95 feet high.

In the courtyard at Burleigh, near Stamford, the seat of the Marquess of Exeter, there is a large and very beautiful tree, figured by Strutt, plate 37, which was in 1822 60 feet high by 10 feet in girth, with a spread of 61 feet diameter. When I saw it in 1903 it was still in perfect health, and was about 80 feet by 12 feet 6 inches. It had remarkably spiny fruit, and its trunk was covered with small twigs.

At Trebartha Hall, near Launceston in Cornwall, Mr. Enys reports in 1904 a tree 15 feet 6 inches in girth, with an estimated height of 70 feet.

In Scotland the horse-chestnut seems as much at home as in England, and thrives in most places as far north as Gordon Castle, where there is a tree, measured in 1881 by Mr. Webster, 65 feet high by 13 feet 4 inches in girth, and 274 feet in circumference of its branches.

At Newton Don, Kelso, the seat of Mr. C. B. Balfour, there is a tree which was in 1906, 13½ feet in girth with a spread of branches of 165 feet in circumference.

In Perthshire there is a very beautiful tree, remarkable for its weeping habit, in the park at Dunkeld, which measures 80 feet in height by 17 feet 6 inches in girth (Plate 64). At Kilkerran, Ayrshire, Mr. J. Renwick has measured a fine tree 84 feet high by 14 feet in girth, with a bole 22 feet high. At Pollok, near Glasgow, a tree measured, in 1904, 63 feet high by 13 feet 6 inches girth at 2½ feet from the ground, with a bole of 5 feet, giving off four great stems.

None of these are equal to a tree in a group of seven standing at the west end of Moncreiffe House in Perthshire, which Hunter[1] describes as the largest in Scotland, and which then measured 19 feet in girth at five feet from the ground. At ten feet it divides into three great limbs, one of which has become firmly rooted in the ground, and extends so far from the trunk that the total spread of the tree is 90 feet in diameter.

The remarkable hardiness of this tree is shown by the existence of one, reported by Mr. Farquharson of Invercauld, as growing at an elevation of 1110 feet, which was supposed to be 177 years old in 1864, when it was 8 feet 7 inches in girth.[2]

In Ireland the horse-chestnut attains a great size, the largest we know of occurring at Woodstock in Co. Kilkenny, on an island in the River Nore. One tree measured in 1904, 93 feet in height by 18 feet 1 inch in girth, and according to the careful records which have been kept of the growth of the many fine trees on this property, measured in 1825, 10 feet 2 inches in girth; in 1846, 13 feet 2 inches; in 1901, 17 feet 9 inches. Another about the same height, in a meadow near the river, measured in 1825, 11 feet in girth; in 1834, 12 feet; in 1846, 12 feet 11 inches; in 1901, 14 feet 4 inches.

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[1] *Woods and Forests of Perthshire*, 1883.

[2] *Old and Remarkable Trees of Scotland*, p. 115.

TIMBER

The wood of the horse-chestnut is one of the poorest and least valuable we have, on account of its softness and want of strength and durability. Though it has a fine close and even grain, white or yellowish-white colour, and is not liable to twist or warp so much as most woods, it does not cut cleanly, decays rapidly, and is only used as a rule for such purposes as cheap packing-cases and linings.

It burns so badly that it is of little use as firewood, and though occasionally cut into veneers or used as a cheap substitute for sycamore, poplar, and lime, in making dairy utensils, platters, and brush backs, it cannot be said to have a regular market. From 4d. to 8d. a foot is about the usual value in most parts of England, though Webster says that it was worth a shilling in Banffshire some years ago.

Holtzapffel says that it is one of the white woods of the Tunbridge turner, a useful wood for brush backs and turnery, preferable to holly for large varnished and painted works on account of its great size.

I am not aware whether it has been tried for pulp-making, but it would seem to be a suitable wood for that purpose on account of its softness, and could, if required, be produced in quantity at a low price. (H. J. E.)

ÆSCULUS CARNEA, RED HORSE-CHESTNUT

Æsculus carnea, Hayne, *Dendrol. Flora*, 43 (1822).
Æsculus rubicunda, Loiseleur, *Herb. Amat.* vi. t. 357 (1822); Loudon, *Arb. et Frut. Brit.* i. 467 (1838); Carrière, *Rev. Horticole*, 1878, p. 370, coloured figure of var. *Briotii*.
Æsculus Hippocastanum, L. × *Æsculus Pavia*, L., Koch, *Dendrologie*, i. 507 (1869).

A small tree, occasionally 50 feet, but rarely exceeding 30 feet in height. Leaves resembling those of the common horse-chestnut, but darker green with an uneven surface, the leaflets being shortly stalked and more or less curved and twisted. Flowers red, showing as they open an orange-coloured blotch at the base of the petals, which afterwards becomes deep red. Petals five, standing nearly erect, their limbs not spreading horizontally at right angles to the claws, as occurs in the common horse-chestnut; edges of the petals furnished with minute glands, like those present in *Æsculus Pavia*. Fruits with slender prickles.

IDENTIFICATION

In winter, the species is distinguished as follows:—Twigs rather stout, grey, shortly pubescent; leaf-scars as in *Æsculus Hippocastanum*. Buds slightly viscid and smaller than in that species; scales brown, edged with a dry membranous dark-coloured rim. Lateral buds small, oval, pointed, arising from the twig at an acute angle.

VARIETIES

1. Var. *Briotii.* Flowers in larger panicles and more brilliantly coloured, the filaments, calyx, and style being red. Fruits never developing fully, falling soon after the flowers. This variety[1] was obtained in 1858, by M. Briot at the State Nurseries of the Trianon, Versailles, as a seedling of *Æsculus carnea.*

2. Several variegated forms are known, as var. *aureo-maculata* and *aureo-marginata.* Var. *alba* is a form with white flowers. Var. *pendula* is pendulous in habit.

3. *Æsculus plantierensis*, André, *Rev. Horticole*, 1894, p. 246, is supposed to be a cross between *A. carnea* and the common horse-chestnut, as it is intermediate in character. This variety arose in the nursery of Messrs. Simon-Louis Frères at Plantières-lès-Metz, from a seed of *Æsculus Hippocastanum.* Other intermediate forms, named by André *Æsculus intermedia* and *Æsculus balgiana*, were derived from seeds of *Æsculus carnea.*

HISTORY

Nothing is known for certain concerning the origin of *Æsculus carnea.* Loiseleur received the plant from Germany in 1818, and there are no earlier accounts of it. Its parentage, however, is undoubted: it possesses characters of both the supposed parents. The leaves and slightly spiny fruit are derived from the common horse-chestnut. The colour of the petals and the glands on their margins come from *Æsculus Pavia.* According to André[2] the seeds when sown usually produce plants which bear whitish flowers and are of no horticultural value. The species is accordingly always propagated by grafting. Koch,[3] however, reports that while some seedlings are like those of the common horse-chestnut, others produce smooth fruits. At Kew, according to Mr. Bean, it has come true from seed.

The largest specimen of this tree that we have seen occurs at Barton in Suffolk. It was 50 feet high in 1904, with a bole, however, of only 2 feet, girthing 7 feet 9 inches at a foot above the ground, and dividing into three stems.

It does not seem to live long or to attain any great size in England, and is often supposed to be a red-flowered form of the common horse-chestnut. (A. H.)

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[1] *Rev. Hort.* loc. cit.

[2] André, *Rev. Hort.* loc. cit.

[3] *Verhand. Ver. Beförd. Gart. König. Preuss. Staat*, 1855.

ÆSCULUS INDICA, INDIAN HORSE-CHESTNUT

Æsculus indica, Colebrooke, Wallich, *List* 1188 (1828); *Bot. Mag.* t. 5117 (1859); Hiern, in *Flora British India*, i. 675 (1875); Bean, in *Gard. Chron.* 1897, xxii. 155 and 1903, xxxiii. 139, *Suppl. Illust.*; Collett, *Flora Simla*, 97 (1902); Gamble, *Man. Indian Timbers*, 193 (1902); Brandis, *Indian Trees*, 185, 705 (1906).

Pavia indica, Wallich, *ex* Jacquemont, *Voyage dans l'Inde*, iv. 31, t. 35 (1844).

A large tree, attaining in India 150 feet in height and 40 feet in girth of stem. Bark in old trees peeling off in long strips. Leaves large, glabrous, dark green above, pale, almost glaucous beneath; leaflets five to nine, stalked, obovate-lanceolate, acuminate, finely and sharply serrate, with about twenty pairs of nerves in the terminal leaflet. Panicles 12 to 15 inches long, loose, narrow, erect. Flowers large, about 1 inch long; calyx $\frac{1}{3}$ inch long, irregularly lobed, often splitting so as to appear two-lipped. Petals four, white, of two unequal pairs; the upper pair narrow and long with a red and yellow blotch at the base, the lower pair flushed with pink. Stamens seven or eight, scarcely longer than the petals, spreading. Fruit brown, rough, without spines, irregularly ovoid, one to two inches long, containing one to three dark brown shining seeds.

IDENTIFICATION

In summer the viscid buds and the large stalked leaflets with finely serrate margins distinguish it from the other species in cultivation. In winter the twigs show the following characters:—Branchlets coarse, shortly pubescent; lenticels like brown raised warts, numerous; pith circular, white; leaf-scars on slightly prominent cushions, each pair wide apart and joined by a raised linear ridge, obovate or semicircular with a raised rim and three groups of bundle-dots. Buds viscid, greenish, the lower scales only being brown; terminal buds ovoid, pointed, the two lowest scales having projecting beaks; scales not ciliate, the outermost four pubescent; lateral buds small, arising at an acute angle.

DISTRIBUTION

It is a common tree in the north-west Himalayas from the Indus to Nepal, occurring at elevations of from 4000 to 10,000 feet, and also occurs in Afghanistan. Sir George Watt informs me that he has measured many trees 150 feet in height with trunks of enormous size, a girth of 40 feet not being uncommon. The wood is used in building and for making water-troughs, platters, vases, cups, packing-cases, and tea-boxes. The twigs and leaves are lopped for use as fodder. The fruit is given as food to cattle and goats; ground and mixed with ordinary flour, it is part of the dietary of the hill tribes. The bark of old trees is very remarkable in appearance, exfoliating in long flakes, which remain attached at their upper ends and hang downwards and outwards. (A. H.)

CULTIVATION

Colonel Henry Bunbury brought seeds from India in 1851, from which plants were raised by Sir Charles J. F. Bunbury[1] at Barton in Suffolk. The large tree[2] now flourishing on the lawn at Barton (Plate 65) is one of the original seedlings, and measured, in 1904, 66 feet high by 7 feet 9 inches in girth. Another tree in the arboretum at Barton measured 65 feet high by 7 feet 2 inches in girth; and divides into two main stems at 7 feet above the ground. This tree flowered for the first time in 1858, producing twelve panicles, being then only seven years old from seed, and 16 feet in height. It did not suffer in the least from the terrible winter of 1860, and flowered as usual in the summer following. In 1868 it ripened fruit, and four thriving plants were raised from its seed. There are no records of the tree on the lawn, which is now the finer of the two. Other trees were planted apparently at Mildenhall,[3] which is about fifteen miles distant from Barton; but these never throve, and none remain. The soil at Mildenhall is a light loam on chalk, and probably did not suit the tree.

I saw the beautiful tree at Barton in full flower on June 24, 1905, when it did not seem to have received the least injury from the severe frosts and cold north-east winds which had occurred a month previously, and which ruined the flowers and destroyed the fruit of the common horse-chestnut in many places.

It seems incredible that this species should be so rare and have remained so little known in England, where it ought to be planted generally in the south and west. Mr. Bean says that the seeds soon lose their vitality if kept dry, and that of some scores received in ordinary paper packets from India in recent years, not one has germinated at Kew. He recommends that the seeds should be gathered as soon as ripe, and be sent packed in fairly moist soil. Mr. Walker, the gardener at Barton, informed me that it ripens seed in good years, and showed me several seedlings raised from them which appeared to grow as well as the common horse-chestnut.

The only other place except Kew, however, where we have seen it, is at Tortworth, where the Earl of Ducie planted in 1890 a few seeds which were sent to him by the late Duke of Bedford. The seedlings were planted at first in sunny places in the open, but did not thrive until moved to a sheltered dell in 1900, where they are now growing well, the best being about 12 feet high.

At Kew there are two or three small trees which have flowered a few times. It seems, therefore, that it only requires a good deep soil and a sheltered situation to succeed as well as it has done at Barton. The late Lord Morley informed me that there was a tree recently planted, but growing very well at Saltram, his place in Devonshire.

According to Jouin,[4] this tree is quite hardy at Metz. (H. J. E.)

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[1] *Arboretum Notes*, 73 (1889).

[2] Figured in *Gard. Chron.* 1904, xxxvi. 206, *Suppl. Illust.*

[3] *Gard. Chron.* 1903, xxxiii. 188.

[4] *Mitt. Deut. Dendrol. Gesell.* 1905, p. 12.

ÆSCULUS TURBINATA, Japanese Horse-Chestnut

Æsculus turbinata, Blume, *Rumphia*, iii. 195 (1847); André, *Revue Horticole*, 1888, p. 496, figs. 120-124; Bean, *Gard. Chron.* 1897, xxii. 156, and 1902, xxxi. 187, fig. 58; Shirasawa, *Icon. Essences Forestières du Japon*, text 113, t. 71, ff. 16-28.
Æsculus chinensis, Masters (*non* Bunge), *Gard. Chron.* 1889, v. 716. fig. 116.

A tree attaining in Japan, according to Shirasawa, 100 feet in height and 20 feet in girth of stem. Bark thick and scaly. Leaves resembling those of the common horse-chestnut, but much larger, mainly differing in the serration, which is finely crenate. Leaflets five to seven, sessile, obovate-cuneate, occasionally as much as 15 inches long, abruptly acuminate, pubescent beneath. The terminal leaflet has fifteen to twenty-two pairs of nerves. Petiole remaining pubescent towards the tip. Panicles 6 to 10 inches long, dense, somewhat narrow. Flowers yellowish-white, smaller than those of *Æsculus Hippocastanum*. Fruit slightly pear-shaped, 1½ to 2 inches in diameter, four to five on a verrucose rhachis, brown, warty, without spines; valves three, thick; seeds usually two.

Identification

In summer only liable to be confused with the European species, from which it is distinguished by the character of the serration of the leaflets. In winter the twigs closely resemble those of that species, but are not so stout; they are similarly pubescent towards the tip, and are marked with smaller but similar five to seven dotted leaf-scars. Buds smaller, equally viscid, the scales, however, not being uniform in colour, but partly light chestnut brown and partly dark brown. Pith large, irregularly circular in cross-section, and yellowish in tint.

Distribution

The tree is known in Japan as *Tochinoki*, and is common in the forests at 1500 to 5500 feet elevation in the mountains of the main island, descending to lower levels in Yezo. It is recorded by Debeaux, *Fl. Shanghai*, 22, from the provinces of Kiangsu and Chekiang; but no one else has seen the tree in China, and Debeaux's identification is probably incorrect.

The exact date of the introduction of the tree into Europe is uncertain, but it is supposed to be about thirty years ago. It has often passed under the name of *Æsculus chinensis*, an entirely different species. It first produced fruit in 1888 in the arboretum at Segrez in France. It flowered in 1901 at Coombe Wood. As only small trees are known to exist in England, the hardiness of the tree and its suitability for garden decoration are as yet unproved; but at Tortworth it is growing vigorously, and has ripened its buds well whilst still quite small;

and the great size of the leaves on the young trees give it a striking and distinctive appearance. (A. H.)

In Japan I saw this tree planted in gardens and parks near Tokyo, where it does not seem to grow so large as in its native forests and in higher, colder situations. Sargent says[1] that in the forests of the interior of Hondo, at 2000 to 3000 feet, it attains 80 to 100 feet high, with trunks 3 to 4 feet in diameter, and that these were perhaps the largest deciduous trees that he saw growing wild in the forest. It reaches its most northern point of distribution near Mororan in Hokkaido at sea-level, and I did not see it near Sapporo, in the Aomori district, or near Nikko. At a tea-house called Hideshira, near the village of Sooga on the Nakasendo road, Central Japan, I saw the largest trees of this species growing in a dense grove with *Zelkova acuminata*. They attained over 80 feet high, with clean trunks 40 to 50 feet long, and a girth of 14 feet.

On the Torii-toge Pass, between Wada and Yabuhara, at about 3300 feet, there were many fine trees growing by the side of the road, of one of which I give an illustration from a photograph taken for me by Masuhara of Tokyo in November (Plate 66).

TIMBER

The timber of this tree, though not highly valued in Japan on account of its softness and want of strength, is used for boat and bridge building, furniture making, house-fittings, and for the groundwork of lacquer. It often shows a waved figure, and when old assumes a pale reddish-brown colour, which makes it very ornamental. Such wood, which I procured at Aomori, has been used with good effect in my Japanese wardrobe, and takes a good polish. It is also much used for trays, and from the large burrs and swellings near the root very handsome trays, as much as 18 or 20 inches square, are carved by the Japanese and sold in the villages at a low price. Its value in Tokyo is given at 60 to 100 yen per 100 cubic feet. I saw a plank of this wood in a timber merchant's shop in Osaka measuring 15 feet long and 58 inches wide, showing wavy figure all through. For this plank 90 yen, equal to about £9, was asked, these immense planks being much valued by Japanese connoisseurs for house decoration. (H. J. E.)

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[1] *Forest Flora of Japan*, 28.

ÆSCULUS GLABRA, Ohio Buckeye

Æsculus glabra, Willdenow, *Enum. Pl. Hort. Berol.* 405 (1809); Loudon, *Arb. et Frut. Brit.* i. 467 (1838), Sargent, *Silva N. America*, ii. 55, tt. 67, 68 (1892), *Man. Trees N. America*, 644 (1905).

Æsculus pallida, Willdenow, *loc. cit.* 406 (1809).

A tree attaining 70 feet in height and 6 feet in girth in America. Bark dark brown and scaly, becoming in old trees ¾ inch thick, ashy-grey, densely furrowed and broken into thick plates roughened on the surface by numerous small scales. Leaves with long slender stalks; leaflets five, oval or obovate-cuneate, long-acuminate, finely serrate in margin, with tufts of hairs in the bases of the serrations, glabrous underneath except for a few hairs along the midrib and tufts in the axils; petiolules short. Terminal leaflet with about fifteen pairs of nerves. Flowers in pubescent panicles, 5 to 6 inches long; calyx campanulate; petals four, pale yellow; claws shorter than the calyx; limbs twice as long as the claws, broadly ovate or oblong in the lateral pair, oblong-spathulate, much narrower and sometimes red-striped in the upper pair. Stamens usually seven, long, exserted, pubescent. Ovary pubescent. Fruit ovate or obovate, brown, 1 to 2 inches long, roughened by prickles.

The species is distinguished in summer by the glabrous leaves, which always show some cilia in the bases of the serrations. In winter the following characters of the twigs and buds may be recognised:—Twigs glabrous, shining, with orange-coloured lenticels. Leaf-scars slightly oblique on obscure leaf-cushions, crescentic or semicircular, with three groups of bundle-dots, the opposite scars wide apart and often not joined by any linear ridge. Pith large, circular, greenish. Buds not viscid; terminal much larger than the lateral, the latter arising from the twig at an angle of 45°; ovoid, acuminate; scales keeled on the back, ciliate in margin, acuminate, the pointed tips being raised outwardly, dark brown.

Var. *Buckleyi*, Sargent (*Æsculus arguta*, Buckley, *Proc. Acad. Phil.* 1860, p. 448), is a geographical form, occurring in Iowa, Missouri, Kansas, and Texas, and characterised by six to seven leaflets, which are sharply and unequally serrate.

No well-marked horticultural varieties are known.

The type occurs in alluvial soil in Atlantic North America, from Pennsylvania to N. Alabama, and westward to S. Iowa, Central Kansas, Indian Territory, and S. Nebraska. Sargent says that it is nowhere very common and from an ornamental point of view very inferior to *Æsculus octandra*.

This species was introduced, according to Loudon, in 1812, but appears to be very rare in this country. At Devonshurst, Chiswick, a tree cut down in 1905 was 60 feet in height by 6 feet in girth, but though the tree probably exists in some nurseries and old gardens, where it is mistaken for *Æsculus octandra*, more commonly than is supposed, we cannot mention any which are remarkable.

(A. H.)

ÆSCULUS OCTANDRA, Sweet Buckeye

Æsculus octandra, Marshall, *Arbust. Am.* 4 (1785); Sargent, *Silva N. America*, ii. 59, tt. 69, 70 (1892), and *Man. Trees N. America*, 646 (1905).

Æsculus lutea, Wangenheim, *Schrift. Gesell. Nat. Fr. Berlin*, viii. 133, t. 6 (1788).

Æsculus flava, Aiton, *Hort. Kew*, i. 403 (1789).

Æsculus neglecta, Lindley, *Bot. Reg.* xii. t. 1009 (1826).

Pavia flava, Moench, *Method.* 66 (1794); Loudon, *Arb. et Frut. Brit.* i. 471 (1838).

A tree attaining in America 90 feet in height and 9 feet in girth of stem. Bark of trunk ¾ inch thick, dark brown, slightly fissured, separating on the surface into thin small scales. Leaves with long slender petioles. Leaflets five, occasionally seven, elliptical or obovate-oblong, cuneate at the base, acuminate, finely serrate, pubescent beneath; petiolules short. Terminal leaflet with twenty or more pairs of nerves. Flowers in pubescent panicles, 4 to 6 inches long; calyx campanulate; petals four, yellow, coming into contact at the tips, very unequal, the upper pair much longer than the lateral pair, claws villose within and much exceeding the calyx, limb of lateral pair obovate or round with a subcordate base, limb of upper pair spathulate, minute. Stamens usually seven, shorter than the petals, villose. Ovary pubescent. Fruit 2 to 3 inches long, brown, smooth or slightly pitted.

Identification

In summer distinguished from *Æsculus glabra* by the leaflets being pubescent beneath and devoid of cilia in the serrations; from *Æsculus Pavia*, by the larger leaves, which have petioles with smooth ridges on their upper surface. In winter the twigs show the following characters:—Branchlets glabrous, shining, with a few scattered lenticels. Leaf-scars flat on the twigs (there being no cushion), obovate, with usually three groups of bundle-dots; opposite scars joined by a linear ridge. Pith large, circular, green or white. Buds not viscid, terminal much larger than the lateral, the latter arising at an angle of 45°, long-oval, pointed at the apex; scales brown, the cilia on the exposed margins minute or absent, upper scales rounded at the apex and on the back, lower pair pointed at the apex and keeled on the back.

Varieties

1. Var. *hybrida*, Sargent (Var. *purpurascens*, A. Gray; *Æsculus discolor*,[1] Pursh). This is a form occurring wild in the Alleghany mountains. The flowers are purple or red in colour, and the under surfaces of the leaves, as well as the petioles and panicles, are clothed with a dense pale pubescence.

2. *Æsculus versicolor*, Dippel. This is a hybrid between *Æsculus octandra* and *Æsculus Pavia*, and is intermediate in character, the flowers varying in

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[1] Figured in *Bot. Reg.* iv. 310 (1818).

colour from yellowish to pink. The edges of the petals show a few glands and are tufted ciliate.

A considerable number of forms of this variety are known in cultivation in which slight differences occur in the length and shape of the petals. *Æsculus Lyoni* and *Æsculus Whitleyi* are apparently sub-varieties of this hybrid. The forms with red flowers are often known in gardens as *Pavia rubra*, a name which belongs properly to *Æsculus Pavia*.

DISTRIBUTION

This tree occurs in alluvial soil of river valleys and on moist mountain slopes, from Pennsylvania southward to Georgia and N. Alabama; and westward to S. Iowa, Indian Territory, and W. Texas. Sargent says that when at its best on the slopes of the Tennessee and Carolina mountains, it sends up a straight shaft sometimes free of branches for 60 to 70 feet, and reaches a total height of 90 feet.

(A. H.)

CULTIVATION

According to Loudon this species was introduced into England in 1764, but though more common in cultivation than any *Æsculus* except *A. Hippocastanum*, and apparently not particular about soil, it does not attain any great size. It is perfectly hardy at Colesborne, and ripens fruit in most years, from which I have raised seedlings, which, however, do not grow so fast or well as those of the common horse-chestnut. A seedling raised from a tree at Tortworth in 1905 was 6 inches high in the first year, and some raised from seed which I gathered in the Arnold arboretum, which germinated earlier, were much injured by the frost of May 21-22.

At Syon there are two trees, probably of a great age, both grafted on the common horse-chestnut. One is 65 feet high by 4 feet 4 inches in girth; the other is 56 feet high by 6 feet 4 inches in girth, with a bole of 7 feet, dividing into three stems, which form a wide-spreading crown. A tree at Belton Park, Lincolnshire, was, in 1904, 50 feet high by 3 feet 4 inches in girth, with a fine straight stem, drawn up in a wood. Another, crowded by other trees near the Broad Water at Fairford Park, Gloucestershire, measures about 60 feet by 4 feet 5 inches. A self-sown seedling was growing near it in 1903. There is also a tree, measuring about 50 feet by 5 feet 6 inches, at Charlton Kings, near Cheltenham.

(H. J. E.)

ÆSCULUS CALIFORNICA, CALIFORNIAN BUCKEYE

Æsculus californica, Nuttall, in Torrey and Gray, *Fl. N. America*, i. 251 (1839); *Bot. Mag.* t. 5077 (1858); Sargent, *Silva N. America*, ii. 61, tt. 71, 72, and *Man. Trees. N. America*, 648 (1905); Bean, in *Gard. Chron.* 1902, xxxi. 187, fig. 57.

A tree, attaining in America 40 feet in height, with a short trunk occasionally 9 feet in girth. Bark smooth, grey or white. Leaves with slender grooved petioles. Leaflets five to seven, stalked, oblong lanceolate, acuminate at the apex, cuneate or obtuse at the base, shallowly and crenately serrate, pale glabrescent beneath. Terminal leaflet, with ten to twelve pairs of nerves. Flowers in dense pubescent panicles, 3 to 8 inches long. Calyx two-lipped, upper lip with three teeth, lower lip with two teeth much shorter than the four narrow oblong petals, which are white or pale rose in colour. Stamens five to seven, long, erect, exserted. Ovary pubescent. Fruit pear-shaped, two to three inches long, smooth, pale brown.

In summer it is readily distinguished from the other species with viscid buds by the small leaves, pale beneath. In winter the twigs are slender, grey, glabrous, with numerous lenticels. Leaf-scars wide apart, joined by a linear ridge, flat on the twig, without a leaf-cushion, crescentic or semicircular, with a row of five to seven bundle-dots. Pith large, circular, white. Terminal buds, larger than the lateral buds, which arise at an acute angle, oval, pointed, glistening with white resin; scales gaping at the apex of the bud, broadly ridged on the back, ciliate in margin, with a tuft of hairs at the apex.

The species is a native of California, where it grows on the banks of streams. A very striking picture of a tree, at San Mateo, California, is given in *Garden and Forest*, iv. 523. It shows a very short forked bole, nearly 20 feet in girth at 2 feet from the ground, and an immense umbrella-shaped head only 32 feet high and 60 feet in diameter, densely covered all over with flowers.

It was introduced in 1855 by Messrs. Veitch, and flowered in their nursery at Exeter in 1858. It fruited[1] at the Bath Botanic Gardens in 1901, and again in 1905, though it remains a shrub. It is perfectly hardy in the south of England, and is remarkable for the beauty of its flowers, which appear in June and July. The best specimen we know of in the country is one which Elwes found growing in a shrubbery at Hutley Towers near Ryde, Isle of Wight. It is about 30 feet high, and was in flower on June 22, 1906. (A. H.)

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[1] *Gard. Chron.* 1902, xxxi. 187.

TSUGA

Tsuga, Carrière, *Traité Conif.* 185 (1855); Bentham et Hooker, *Gen. Pl.* iii. 440 (1880); Masters, *Journ. Linn. Soc.* (*Bot.*) xxx. 28 (1893).

Hesperopeuce, Lemmon, *Rep. Calif. State Board Forestry*, iii. 111 (1890).

Evergreen trees belonging to the natural order Coniferæ. Branches horizontal or pendulous, pinnately and irregularly ramified. Buds, one terminal and a few lateral, arising irregularly in the axils of some of the leaves of the current year's shoot, most of the leaves being without buds in their axils. Leaves linear, arising from the branchlets in spiral order, and usually thrown by a twisting of their petioles into a pectinate arrangement, or in one species spreading radially. Petioles short, arising from prominent leaf-bases on the branchlets, appressed against the twigs, a sharp angle being formed by the leaf with the stalk at the point of junction. The leaf has one resin-canal, lying in the middle line between the vascular bundle and the epidermis of the lower surface. The leaves persist for several years; and all the species have in consequence of this and their numerous and fine branchlets very dense foliage.

Flowers monœcious. Male flowers in the axils of the leaves of the previous year's shoot near its apex, composed of numerous spirally arranged, short-stalked, two-celled anthers, with glandular-tipped connectives. Female flowers terminal on lateral shoots of the previous year, short-stalked or sub-sessile, erect, composed of spirally arranged, nearly circular scales, and membranous, usually shorter bracts. Ovules, two on each scale. Cones solitary, small, composed of concave woody imbricated scales, which persist on the axis of the cone after the escape of the seeds, and of inconspicuous bracts, which, except in one species, are concealed between the scales. The cones, ripening in one season, allow the seeds to fall out in the first autumn or winter, but remain on the tree until the summer or autumn of the second year. The seeds, two on each scale, are minute, furnished with resin vesicles and winged. The seedling has three to six cotyledons, which bear stomata on their upper surface.

Tsuga is confined to temperate North America, Japan, China, and the Himalayas. The genus consists of nine species, and is divided into two sections:—

I. *Hesperopeuce*, Engelmann, in Brewer and Watson, *Bot. California*, ii. 121 (1880).

Leaves rounded or keeled above, bearing stomata on both surfaces, and radially arranged; the shorter and lateral branchlets standing in a plane at right angles to the longer and terminal ones. Cones oblong-cylindrical, large, composed of numerous (about seventy) scales.

This section includes one species :—

1. *Tsuga Pattoniana*, Sénéclauze. Western North America.

II. *Micropeuce*, Spach, *Hist. Vég.* xi. 424 (1842), identical with *Eutsuga*, Engelmann, *loc. cit.* 120 (1880).

Leaves flat, grooved above, bearing stomata on the lower surface only, pectinately arranged on the branchlets, which are all in one plane. Cones ovoid, small, composed of few scales, rarely more than twenty-five.

This section comprises the remaining species, of which six are in cultivation in this country. These may be conveniently arranged as follows :—

A. *Leaves serrulate in margin. Shoots pubescent.*

2. *Tsuga Canadensis*, Carrière. Eastern North America.

Leaves, ⅓ to ⅔ inch long, usually tapering from the base to the acute or rounded apex ; lower surface marked with two narrow well-defined white stomatic bands, the part of the leaf external to them being pure green in colour. Buds brown, ovoid, pointed, composed of pubescent, keeled acute scales.

3. *Tsuga Albertiana*, Sénéclauze. Western North America.

Leaves, ¼ to ¾ inch long, usually rounded at the apex and uniform in breadth ; lower surface with two ill-defined broad white stomatic bands, which are indistinctly continued to the margins, there being no distinct bands of pure green. Buds greyish, ovoid, apex obtuse and flattened ; scales keeled, pubescent.

4. *Tsuga Brunoniana*, Carrière. Himalayas.

Leaves, 1 to 1¼ inch long, gradually tapering from the base to the acute apex ; lower surface silvery white, stomatic bands well-defined and extending almost to the margins. Buds globose, flattened on the top, surrounded at the base by a ring of modified leafy scales, the other scales ovate, acute, pubescent.

B. *Leaves entire in margin. Shoots glabrous.*

5. *Tsuga Sieboldii*, Carrière. Japan.

Leaves, ½ to 1 inch long, oblong, rounded and notched at the apex, shining above ; lower surface with two narrow well-defined white stomatic bands. Buds red, ovoid, slightly acute at the apex ; scales glabrous and ciliate.

C. *Leaves entire in margin. Shoots pubescent.*

6. *Tsuga diversifolia*, Maximowicz. Japan.

Shoots pubescent, both on the leaf-bases and in the furrows between them. Leaves, ¼ to ½ inch long, oblong, rounded and notched at the apex ; lower surface with two narrow well-defined white stomatic bands. Buds red, pyriform, flattened above ; scales obtuse, minutely pubescent.

7. *Tsuga Caroliniana*, Engelmann. Southern Alleghany Mountains.

Shoots pubescent in the furrows between the leaf-bases, which are glabrous.

Leaves, ¼ to ¾ inch long, oblong, rounded at the apex, which is entire, minutely notched or mucronate; lower surface with two narrow well-defined white stomatic bands. Buds reddish, ovoid, sharp-pointed; scales indistinctly keeled.

In addition to the preceding, two species of Tsuga, belonging to this section, occur in China. They are as yet imperfectly known. *Tsuga chinensis*, Masters,[1] a native of the high mountains of Szechuan, is closely allied to *Tsuga diversifolia*, and, like it, has pubescent young shoots. It differs in the cones, which are quite sessile, and have very lustrous scales. The leaves are described as being green beneath; but this is probably an inconstant character.

Tsuga yunnanensis, Masters,[2] which was discovered by Père Delavay in the mountains near Likiang in Yunnan, is unknown to me. Franchet considers it to be closely allied to *T. Sieboldii*.

TSUGA PATTONIANA, Hooker's Hemlock

Tsuga Pattoniana, Sénéclauze, *Conif.* 21 (1867); Engelmann, in Brewer and Watson, *Bot. California*, ii. 121 (1880); Masters, *Gard. Chron.* xii. 10, fig. 1 (1892).
Tsuga Hookeriana, Carrière, *Traité Conif.* 252 (1867); and Lemmon, *Erythea*, vi. 78 (1898).
Tsuga Mertensiana, Sargent, *Silva N. Amer.* xii. 77, t. 606 (1898), and *Trees N. Amer.* 51 (1905); Kent, Veitch's *Man. Coniferæ*, 468 (1900).
Pinus Mertensiana, Bongard, *Végét. de Sitcha*, 54 (1832).
Pinus Pattoniana, Parlatore, *D. C. Prod.* xvi. 2, p. 429 (1864).
Abies Pattoniana, Balfour, *Rep. Oregon Assoc.* 1 (1853); Murray in Lawson, *Pin. Brit.* ii. 157 (1884).
Abies Hookeriana, Murray, *Edin. New Phil. Journ.* 289 (1855); and in Lawson, *loc. cit.* 153.
Abies Williamsonii, Newberry, *Pacific R. R. Report*, vi. pt. iii. 53, t. 7, fig. 19 (1857).
Hesperopeuce Pattoniana, Lemmon, *Rep. Calif. State Board Forestry*, iii. 128 (1890).

A tree, occasionally attaining in America 150 feet in height, with a girth of 15 feet. Bark dark cinnamon in colour, deeply divided into rounded connected scaly ridges. Shoots brownish-grey, and densely pubescent. Branchlets in different planes, the shorter and lateral ones usually arising on the upper side of the longer and terminal ones, and disposed at right angles to them, giving a tufted appearance to the branch. Leaves radially arranged on the branchlets, not markedly different in size, ¾ to 1 inch long, curved, linear; apex usually rounded and obtuse, rarely acute; upper surface convex and keeled towards the apex; lower surface rounded with a median groove; both surfaces with about eight lines of stomata, which are sparse and do not form conspicuous white bands; margin entire. Buds brownish, ovoid, acute at the apex, composed of a few closely imbricated, strongly keeled scales.

Cones sessile, about two inches long, oblong cylindrical, tapering at the apex and slightly narrowed at the base, composed of five series of scales, each series with fourteen to fifteen scales. Scales thin, broader than long, semicircular with a wedge-shaped base, convex, margin irregularly denticulate, pubescent on both surfaces. Bract oblong, abruptly tapering at the apex, which is visible between the scales. Seed with terminal asymmetrical wing, and two resin-vesicles on the side next the scale.

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[1] *Journ. Linn. Soc.* (*Bot.*) xxvi. 556 (1902); *Abies chinensis*, Franchet, *Journ. de Bot.* 1899, p. 259.

[2] *Journ. Linn. Soc.* (*Bot.*) loc. cit.; *Abies yunnanensis*, Franchet, *loc. cit.* p. 258; and *cf.* also Masters, *Journ. Linn. Soc.* (*Bot.*) xxxvii. 421 (1906), who identifies the specimens from Szechuan with this species; but judging from Franchet's description, they are the other species.

The name Pattoniana is adopted as being the first published under the correct genus Tsuga. The tree is known to American botanists as *Tsuga Mertensiana*, which is unfortunate, as this name was for many years in use for the western hemlock. There is no confusion possible if *Pattoniana* be selected, as no other hemlock has been known at any time by this name.

VARIETIES

The preceding description is drawn up from living specimens of the form with bluish entire leaves, cultivated in this country, and applies, in all essential characters, to dried specimens from trees growing wild in America. I have examined the material in the Kew herbarium and also specimens collected by Elwes on Mount Shasta at 7500 feet elevation; and there do not appear to be two distinct varieties of the tree in the wild state, as the presumed alpine form is only a stunted shrub which agrees in botanical characters with the trees from lower levels.

In England, however, there is a form in cultivation, distinguished by its green serrulate leaves, which differs in many respects from the other form. Concerning its origin, we only know, on the authority of Murray,[1] that it was raised at Edinburgh from seeds collected by Jeffrey in 1851 on the Mount Baker range in British Columbia. Jeffrey found trees growing there from 5000 feet elevation to the snow line, varying in size from 150 feet in height and 13½ feet in girth at lower levels to a stunted shrub not more than 4 feet high close to the timber line. Specimens at Kew from Mount Baker gathered by Jeffrey all have entire leaves and belong to the ordinary wild form.

Engelmann,[2] who visited the Mount Baker range, states that the trees growing there are the ordinary forms of *Tsuga Pattoniana* and *Tsuga Albertiana*. He suggests that the plants raised from Jeffrey's seed may be a mountain form of the latter species; but this cannot be admitted, as they do not resemble that species in botanical characters (buds, leaves, etc.). It is possible that these plants are only a seedling variation of *Tsuga Pattoniana*, and do not correspond with any distinct species or geographical form in the wild state.

Murray,[3] believing that he had two species to deal with, named the bluish form *Abies Hookeriana*, and assigned the name *Abies Pattoniana*, Balfour, to the other form. The original figure of Balfour's species represents, however, the same plant as *Abies Hookeriana* of Murray; and much confusion has resulted in consequence in the use of the two names *Hookeriana* and *Pattoniana*. It is most convenient to apply the name *Pattoniana* to the bluish form, as it is the earliest name of the wild plant, and to consider the green-foliaged plant to be a variety of it, which may be called var. *Jeffreyi.*

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[1] *Edin. New. Phil. Jour.* 289 (1855) and *Proc. Hort. Soc.* ii. 202 (1863).

[2] *Gard. Chron.* xvii. 145 (1882).

[3] The distinctions relied on by Murray in the cones are trifling; and in the Kew Herbarium there are wild specimens showing these differences, but all belonging to the form with blue entire leaves. I have not seen cones belonging to the other form.

The two forms are distinguished as follows :—

1. Var. *typica.* The form distinguished in cultivation by its bluish foliage. Introduced in 1854 by William Murray, who found the tree on Scots Mountain, in California.

Leaves, though radially arranged, tending on the lower side of the shoot to be in the plane of the branch and not spreading; those on the upper side of the shoot curved and directed outwards and forwards. They are long and narrow, ½ to ⅞ inch long, and $\frac{1}{20}$ inch wide, entire in margin, convex on both surfaces, the groove in the median line above being very short or absent and never continued to the apex of the leaf, which is rounded or acute; both surfaces marked with conspicuous lines of stomata extending from the base to the apex of the leaf.

2. Var. *Jeffreyi.* Only known in cultivation, distinguished by its greenish foliage.

Leaves spreading radially and directed outwards (never forwards) on all sides of the shoot; straight, short, and broad, less than ½ inch long and about $\frac{1}{16}$ inch in width, serrulate in margin; upper surface flattened and distinctly grooved, the groove continued to the rounded apex; lower surface convex, with lines of stomata the whole length of the leaf. On the upper surface the stomata only occur in four to six broken lines towards the apex.

This form agrees with the typical form in the character of the buds and pubescence of the branchlets; the shoots, however, are not so slender.

(A. H.)

Mr. Gorman gives the following account[1] of the supposed Alpine form, alluded to above :—"Among the hardy alpine trees Hooker's hemlock stands pre-eminent, having a northern range far beyond that of even the white-barked pine. It is a small, dwarfed and stunted tree compared with the type, and seldom exceeds 12 inches diameter or 30 feet in height. It usually ranges in altitude from 5500 to 6400 feet, but is occasionally found up to and beyond 7000 feet where it can find sufficient moisture. Though generally favouring the heads of moist valleys it is sometimes to be found on the leeward side of peaks and slopes, where snowbanks of sufficient size have formed in winter to maintain an adequate supply of moisture during the rest of the year. It is in the latter situations where the tree reaches its highest altitude. In addition to its smaller size and more alpine habit it further differs from its nearest congener in having thinner bark and *small erect* cones, all the other hemlocks having pendent cones. The tree is too small and inaccessible to have any economic value."

This seems to be distinguished principally by its erect cones. Sargent,[2] who alludes to Gorman's account, does not consider this variation to be worthy of distinction, and explains it by saying that the position of the cones "is evidently due to the thickness of the short lateral branchlets, on which they are terminal and which are sometimes so rigid that the weight of the cones does not make them pendent."

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[1] *Survey E. Part Washington Forest Reserve*, p. 336 (19*th Ann. Report of the Survey*, Part v. 1899).

[2] *Silva N. Amer.* xii. 78, note 1.

DISTRIBUTION

This tree is only found at high elevations, where it has much the same geographical range as the western hemlock, but it extends farther south in California and reaches its southern limit at 9000 to 10,000 feet on the south fork of King River in the Sierra Nevada.

In the north it descends to sea level on Baranoff Island, and on the shores of Yes Bay in Alaska, lat. 55° 54′ N., where Mr. Martin Gorman collected it. As a rule it is a tree of high altitudes, growing on exposed ridges and slopes near the upper limit of the forest, in company with *Abies lasiocarpa*, *Picea Engelmanni*, and *Pinus albicaulis*. In the Rocky Mountains of British Columbia Mrs. Nicholl found it as a good-sized tree near Glacier up to 7000 feet, though Wilcox,[1] in his excellent account of the trees of that region, pp. 61-65, does not mention it.

Though usually a more or less stunted and ragged tree, it attains a large size on the Cascade Mountains, where I saw it in perfection on the road from Longmire Springs to Paradise Valley, on the south side of Mount Tacoma,[2] in August 1904, first at about 4000 feet, where it was only a scattered tree, and higher up it mixed with the western hemlock in a splendid forest. I was not able to distinguish the two species by their bark, though when not crowded, the habit of Hooker's hemlock is very distinct; but they could be identified by the fallen cones under the trees. The largest that I measured here was about 150 feet by 13 feet 8 inches. Higher up, where the forest[3] opened out into glades at the bottom of the Paradise Valley, which is, in Professor Sargent's opinion, one of the most interesting in America for its alpine flora, it assumed a different and more flat-topped habit; the largest here that I measured was 108 feet by 13 feet 3 inches. It grew in company with *Abies lasiocarpa*, and seedlings of both were numerous on rotten logs on the shady sides of the clumps in which they always grew.

The tree in a very stunted state reaches the timber line—about 7500 feet—in company with *Abies lasiocarpa* and *Cupressus nootkatensis*; but in California, J. Muir[4] measured a specimen at 9500 feet, near the margin of Lake Hollow, which was 19 feet 7 inches in girth at 4 feet from the ground.

Mr. Gorman gives an excellent account of the tree in his *Survey of the Eastern Part of the Washington Forest Reserve*, pp. 335-336, from which I quote as follows:—

"This hemlock is confined to the moist valleys and vicinity of the passes. It is the prevailing tree in Cascade Pass, 5421 feet, and is quite common about the sources of the Stehekin, where it attains a very fair size for this region, ranging from 50 to 90 feet in height and from 12 to 27 inches in diameter. The altitudinal range is greater than was expected, from 3100 feet to 5800 feet, and a tree supposed to be of this species was found as low as 2100 feet in the Stehekin Valley.

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[1] *The Rockies of Canada*, 61-65 (1900).

[2] The local name is Mount Tacoma, but in maps and writings it is usually called Mount Rainier.

[3] An account of this forest, with two beautiful illustrations of "Patton's spruce," is given in *Garden and Forest*, x. 1, figs. 1, 2 (1897).

[4] *Mountains of California*, p. 20.

"The tree is sometimes taken for the western hemlock, but may be distinguished by the erect top of the sapling, the cones long, purple, and more or less massed about the top of the tree; and the mature tree has an unusually thick, roughly corrugated bark: while in the western hemlock the top is generally drooping, the cones small, oval, and brown, and well distributed over the branches, and the mature tree has a comparatively thin bark. The wood is close grained and of fine texture, and is quite suitable for lumber or fuel, but is not much used on account of its growing usually in inaccessible situations."

Near Crater Lake in Southern Oregon, Mr. Leiberg (*Cascade Forest Reserve Report*, pp. 245, 259), says:—"A few scattered groves of Patton hemlock occur in the southern tracts, some of which are of large size, occasional individuals reaching six to seven feet in diameter. Occasional stands of Patton hemlock 200 to 300 years old exhibit fine proportions at this elevation, 6000 feet; the species usually grows in close groups, composed of ten or twenty individuals, collected together on what appears to be a common root; such close growth develops clear trunks, though not commonly of large diameter. Stands of this character sometimes run as high as 25,000 feet per acre."

REMARKABLE TREES

Though now introduced for about fifty-five years this tree has made but little show in our gardens, as the climate of most parts of England is probably too warm for it. I have seen flourishing specimens of no great size in several places, the best, perhaps, being one at Tyberton Court, Herefordshire, the seat of Chandos Lee Warner, Esq., where there is a tree of the typical form 43 feet high by about 3½ feet in girth, said to be fifty years old, and perhaps one of those introduced by William Murray, and sent out by Lawson.

In Scotland it seems to thrive even better, especially at Murthly Castle, where there is a fine group of trees on a lawn (Plate 67). When measured for the Conifer Conference in 1892 the best of these was 35 feet by 3 feet 10 inches, another 30 feet by 4 feet. When I last saw them in September 1906 the tallest tree on the left of the row was 47 feet by 3 feet 8 inches, the tree in the middle with weeping branches 43 feet by 4 feet 2 inches, and the thickest between these two was 6 feet 7 inches in girth. The difference in the habit of these three is well shown in the plate. They produced seed in 1887, from which a number were raised and planted at Murthly. These have grown slowly, and the tallest in 1906 were six or seven feet high, though quite healthy; and the growth of seedlings which I raised from seed gathered on Mount Rainier is extremely slow.

At Keillour, Henry measured, in 1904, a specimen which was 40 feet by 3 feet 9 inches; and at the Cairnies, near Perth, the seat of Major R. M. Patton, there were in 1892 two specimens little inferior to those at Murthly. (H. J. E.)

TSUGA ALBERTIANA, Western Hemlock

Tsuga Albertiana, Sénéclauze, *Conif.* 18 (1867); Kent, Veitch's *Man. Coniferæ*, 459 (1900).
Tsuga Mertensiana, Carrière, *Traité Conif.* 250 (1867); Masters, *Gard. Chron.* xxiii. 179, fig. 35 (1885).
Tsuga heterophylla, Sargent, *Silva N. Amer.* xii. 73, t. 605 (1898), and *Trees N. Amer.* 50 (1905).
Abies heterophylla, Rafinesque, *Atlantic Jour.* i. 119 (1832).
Abies Mertensiana, Gordon, *Pinetum*, 18 (1858).
Abies Albertiana, A. Murray, *Proc. Roy. Hort. Soc.* iii. 149 (1863).

A large tree, attaining in America 200 to 250 feet in height and 20 feet or more in girth, narrowly pyramidal in habit. Bark of old trees reddish brown, and deeply divided into broad, flat, connected scaly ridges. Young shoots whitish grey, and covered with short pubescence, intermixed with scattered long straggling hairs. Leaves pectinately arranged, the shorter leaves on the upper side of the branchlets, those in the median line above often parallel to the twig and directed forwards, exposing their stomatic surfaces. The leaves are ¼ to ¾ inch long, linear-oblong, uniform in width, serrulate in margin, dark green above, with a median groove continued up to the rounded apex; under surface with inconspicuous midrib and two broad white stomatic bands, which are ill defined on the outer side, there being no distinct marginal green bands. Buds greyish brown, ovoid, with an obtuse and flattened apex; scales keeled and pubescent.

Cones sessile, about one inch long, ovoid, composed of five series of scales, each series with six to seven scales. Scales spathulate, nearly twice as long as broad, wider in the upper half, abruptly narrowed below, rounded with a slightly acute apex, entire and slightly bevelled in margin, striate and slightly pubescent on the outer surface. Bract small, concealed, lozenge-shaped, pubescent and keeled. Seed with a very long wing, decurrent on the outer side of the seed to the base; seed with wing about three-fourths the length of the scale.

The young seedling has three to four cotyledons, which are a little more than ¼ inch in length, gradually tapering to an acute apex, sessile, flattened beneath, the upper surface two-sided and bearing stomata, margin entire. The young stem is pubescent and bears first two to three whorls of true leaves (three in each whorl), which are serrulate, shortly stalked, and bearing stomata on their upper surface. These are succeeded by leaves borne spirally. The cotyledons are supported by a caulicle, reddish and glabrous, about an inch in length, which terminates in a very slender flexuose tap-root.

The name *Albertiana* has been chosen, as it appears to have been published as early as that of *Mertensiana* under the correct genus Tsuga. *Tsuga Mertensiana* is now the name given by American botanists to *Tsuga Pattoniana*, and its adoption would cause considerable confusion. *Albertiana*, never having been applied to any other species, is correct on the grounds of common sense as well as of priority. (A. H.)

DISTRIBUTION

On the west coast of North America it extends southwards from south-eastern Alaska, where it forms the greater part of the great coast forest, which reaches from sea-level up to about 2000 feet, and is associated with Menzies's spruce.

In British Columbia it is very abundant on the coast, and extends as far inland as the heavy rainfall reaches up the valley of the Frazer, on the Gold and Selkirk ranges, and east of the Columbia valley nearly up to the continental divide.[1] In Vancouver's Island it forms with the Douglas fir and red cedar a large though not economically important part of the forest. In Washington and Oregon it is also one of the principal elements of the forest, of which, in the Cascade Forest Reserve, it forms about nine per cent of the timber,[2] and extends up to 5000 feet, crossing the watershed of the coast range in lat. 45°.

In the drier parts of southern Oregon it becomes rare, and though it occurs in the redwood forests of northern California as far south as Cape Mendocino, I did not see it on the Siskyou mountains or on Mount Shasta. In the interior it is found in the wetter parts of northern Montana, Idaho, and in southern British Columbia, where, in company with Douglas spruce, *Picea Engelmanni*, *Abies grandis*, and *Larix occidentalis*, it sometimes forms a considerable part of the forest, and reaches up to 6000 feet in the Cœur d'Alène mountains, though I did not see it in the valley of the Blackfoot river, near Missoula, where the climate is drier.

It attains its finest development on the coasts of Washington and Oregon, where Sargent says that it attains 200 feet in height, with a stem 20 to 30 feet in girth. Plummer, in his Report on the Mount Rainier Forest Reserve,[3] says (p. 101) that it attains an extreme diameter of 6 feet, with a height of 250 feet, of which half to two-thirds is crown. The largest that I actually measured, however, on my visit to Mount Rainier in August 1904, were under 200 feet, with a girth of 12 to 14 feet, and these were growing mixed with *Tsuga Pattoniana* at an elevation of 4000 to 5000 feet.

In the Cascade Reserve Forest of northern Oregon, near Bridal Veil, at about 3500 feet elevation, I measured and Mr. Kiser photographed a tree 175 feet high and 16 feet 6 inches in girth, with a clean bole of about 60 feet, but I am unable to reproduce this, as the negative has not arrived.

The growth of seedlings in all the forests that I saw was exceptionally good. Mr. H. D. Langille says,[4] p. 36 :—

"Certain cone-bearers are better adapted for restocking than others, though the reasons are not apparent. For example, young lovely firs (*A. amabilis*) are abundant everywhere within the zone of that species, whilst noble fir (*A. nobilis*), having a cone and seed of very similar size and nature, seldom germinates, and a seedling of that species is rarely seen.

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[1] Mrs. Nicholl, who explored the Rocky Mountains in 1904 and 1905, tells me that it is a large tree at Glacier, on the Canadian Pacific Railway, and grows up to about 5000 feet.

[2] *Forest Conditions of Cascade Reserve*, p. 25, Washington, 1903.

[3] *Twenty-first Annual Report of the U.S. Geological Survey*, part v. Washington, 1900.

[4] *Forest Conditions in Cascade Reserve*, U.S. Geological Survey, Washington, 1903.

"From many observations made in the zone of the hemlock and lovely fir, it is apparent that these trees, from their ability to thrive under the most adverse conditions, are rapidly superseding the others, and will, under natural conditions, be the sole components of the alpine forests. It is a striking fact that, upon many areas where from 50 to 100 per cent of the present forest is red fir (Douglas), the reproduction is entirely hemlock and lovely fir. Should these forests be destroyed by fire it is probable that red fir would rival these species in restocking the burn ; but under natural conditions it is evident that the red fir will be displaced, and the limits of the alpine trees become much lower than at present.

"The yellow pine (*P. ponderosa*), in some instances, does good work in stocking open spots in the timber, but seldom extends far beyond the parent tree. In the yellow pine forests most of the young growth is red or white fir (*A. grandis*), which, taking advantage of the shade and moisture afforded by the yellow pine cover, is growing rapidly, and will in time form a larger percentage of the forest than it has in the past."

I can confirm this from my own observation both in the Cascade Forest and in Vancouver's Island. The seedlings germinate most freely when they fall on the moss-covered rotting trunk of a fallen tree, along which a complete row of young trees often grows ; and Plate 59, vol. i. shows a tree of this species, probably 150 years old, whose roots had completely enclosed the still sound trunk of a red cedar (*Thuya plicata*). A valuable paper[1] by Mr. E. T. Allen, dealing with the western hemlock from a forestry point of view, has been published by the U.S. Bureau of Forestry.

CULTIVATION

It was introduced in 1851 by Jeffrey, and named in 1863 by Murray, at the request of Queen Victoria, in memory of the late Prince Consort, who was a patron of the Oregon Association, and President of the Royal Horticultural Society.[2]

In grace, freedom of growth, and adaptability to varied conditions of culture, in England this, as an ornamental tree, is second to none, and much superior to any other hemlock. Though it has been in cultivation little over fifty years it has already attained a height of about 90 feet in such widely distant counties as Kent, Devonshire, and Perthshire.

The only soils on which it will not thrive are chalk, limestone, and heavy clay, and though it enjoys all the moisture that the wettest parts of England afford, it wants, like all its congeners, a well-drained soil and a sheltered situation.

It ripens seed abundantly in England, and has sown itself in several localities, especially at Blackmoor, the seat of the Earl of Selborne, where there are several self-sown trees, of which the best, growing on the lower greensand formation, is, at about fifteen years old, 10 to 12 feet high, though the parent trees do not exceed about 65 feet.

In Fulmodestone Wood, on Lord Leicester's estate in Norfolk, I have also seen self-sown seedlings ; and though they are very slow in growth for the first four or five years, yet if kept moist and shaded in a mixture of sand and leaf-mould they may be planted out at five to six years old, with every hope of success.

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[1] "The Western Hemlock," *U.S. Dept. Agric. Forestry Bulletin*, No. 33 (1902).

[2] Hunter, *Woods of Perthshire*, p. 359.

So far as my experience goes, trees grown from cuttings are not so satisfactory, and there is no excuse for this practice except the saving of trouble, as seedlings are raised in quantity at a very low cost from home-grown seed in Scotland, as I have seen in the nursery at Murthly Castle.

REMARKABLE TREES

Among so many fine trees of this species, all of about the same age, it is hard to choose, but perhaps the largest[1] which we have measured is at Hafodunos, in Denbighshire, which in 1904 was found by Henry to be 94 feet 6 inches by 8 feet 5 inches, and this tree has also produced self-sown seedlings.

At Dropmore there is a very beautiful tree of the spreading type (Plate 68), about 70 feet by 6 feet. At Hemsted, in Kent, I was shown by Lord Cranbrook, in 1905, a tree which is perhaps as tall as any in England, but which, growing in a hole and surrounded by other trees, it was not possible to measure accurately. It is, however, about 90 feet by 4 feet 11 inches, well shaped and growing fast.

At Penllergare, near Swansea, the seat of Sir J. T. D. Llewellyn, Bt., are several fine trees growing in a sheltered valley, which were planted about fifty years ago in company with *Tsuga canadensis.* They are now from 70 to 80 feet high, whilst the best of the eastern hemlock is only 50 feet, and the difference in habit of the two trees is very well shown.

A very large tree, reported[2] to be 110 feet high, is growing at Singleton Abbey, near Swansea, the residence of Lord Swansea, but I have been unable as yet to get confirmation of the height stated. At Castlehill, N. Devon, are several fine trees, the best of which, on a steep bank above a waterfall, where it is somewhat drawn up by beeches, is 90 feet by 6 feet 7 inches. At Carclew, Cornwall, is a fine tree, which in 1902 was 80 feet by 6 feet 3 inches, and in 1905, 82 feet by 6 feet 6 inches, both measurements taken by myself.

At Barton, Suffolk, a young and very thriving tree, shut in by tall beeches and conifers, in 1905 was 80 feet by 4 feet 3 inches, a remarkable instance of height as compared with girth.

In Scotland the tree flourishes exceedingly, and has been planted in many places. Perhaps the tallest is one at Castle Menzies, which in 1904 I made about 90 feet by 7 feet 8 inches, though the gardener thinks it is taller; but one of the most beautiful for its shape, graceful habit, and situation, grows by a deep shady burn on the road from Dunkeld to Murthly Castle, and is about 70 feet by 5 feet (Plate 69), and there are many other fine trees in the grounds there. A tree at Riccarton, near Edinburgh, planted in 1855, measured in 1905, 73 feet by 7 feet 1 inch. A very large tree, measuring in 1907, 10 feet in girth, is reported by Major P. J. Waldron, to be growing at Hallyburton, Coupar-Angus, the seat of Mr. W. Graham Menzies.

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[1] This tree was in 1868, 28½ feet high by 2 feet 3 inches in girth at the base. In 1883 it measured 65 feet by 4 feet 11 inches at 3 feet from the ground (*Gard. Chron.* 1868, p. 657, and 1885, xxiii. 179). According to the owner, Colonel Sandbach, it was planted probably in 1856.

[2] *Gard. Chron.* xxxvii. 136 (1905).

The only place where the tree is reported to have been killed by frost is in the plantations at the Cairnies, Perthshire, where Hunter says (p. 364) that in the severe winter of 1880-81 many were injured and some killed. Two of the finest specimens in Scotland are, however, growing in the grounds at this place.[1]

In Ireland the best specimen we know of is one at Glenstal, Co. Limerick, which measured in 1903, 78 feet high by 7½ feet in girth. One of exactly the same height by 6 feet in girth is growing at Kilmacurragh, Co. Wicklow; and around it are several self-sown seedlings. At Mount Usher, in the same county, there is a fine specimen, 28 years old, from seed, which was 57 feet high by 4 feet 5 inches in 1903.

TIMBER

The timber of the western hemlock has not until recently been much valued, or cut for lumber, on account of its supposed inferiority to that of the Douglas spruce, and is often left standing by loggers, but the increasing scarcity of lumber in some districts has led to its being converted into boards, and it is now largely used for the construction of buildings. Sargent says that it is light, hard, and tough, stronger, more durable, and more easily worked than the other American hemlocks. Allen[2] says that in strength it cannot be classed with oak, red fir, or longleaf pine, nor is it suitable for heavy construction, especially where exposed to the weather; but it possesses all the strength requisite for ordinary building material. It is largely used in Washington for mill frames.

At Mr. Bradley's sawmill at Bridal Veil, Oregon, I saw it being manufactured, and brought away a sample which quite bears out Sargent's high opinion of it. If such timber existed in Japan or in Europe, I am sure it would be highly valued for joinery, but so far as I can learn none has yet been shipped to Europe. Hemlock timber[2] has been exported to Manila, and is likely to prove of considerable value in the tropics for housebuilding and indoor finish, as it appears to be free from the attacks of white ants. The wood is distasteful to rodents, and is used on that account by farmers for the construction of oat-bins.

The bark, according to Sargent, forms the most valuable tanning material produced on the west coast of North America, and the inner bark is eaten by the Indians of Alaska.

James M. Macoun[3] says of it—"The abundance of other wood of better quality has prevented the hemlock from coming into general use, and the same prejudice exists in British Columbia against the western tree that prevailed until very recently against hemlock in eastern Canada. Though its grain is coarse, western hemlock is for many purposes just as serviceable as other woods which cost more. The bark is rich in tannin, but is too thin to be extensively used while there is such an abundance of Douglas fir in the same region." (H. J. E.)

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[1] These are trees growing in peat soil at 635 feet altitude. The seeds were sown in 1853, and in 1868 one tree was 29 feet by 1 ft. 11 in., and the other 26 feet by 2 feet at three feet from the ground (*Gard. Chron.* 1868, p. 518).

[2] Allen, "Western Hemlock," 20, 21 (*U.S. Forestry Bulletin*, No. 33, 1902).

[3] *Forest Wealth of Canada*, 82 (1904).

TSUGA CANADENSIS, HEMLOCK OR HEMLOCK SPRUCE

Tsuga canadensis, Carrière, *Traité Conif.* 189 (1855); Sargent, *Silva N. Amer.* xii. 63, t. 603 (1898), and *Trees N. Amer.* 48 (1905); Kent, Veitch's *Man. Coniferæ*, 463 (1900).
Pinus canadensis, Linnæus, *Sp. Pl.* 1421 (1763); Lambert, *Genus Pinus*, i. t. 32 (1803).
Abies canadensis, Michaux, *Fl. Bor. Am.* ii. 206 (1803), and *Hist. Arb. Amer.* i. 137, t. 13 (1810); Loudon, *Arb. et Frut. Brit.* iv. 2322 (1838).
Picea canadensis, Link, *Linnæa*, xv. 523 (1841).

A tree attaining in America over 100 feet in height, but usually only 60 to 70 feet, with a girth of 12 feet as a maximum. Bark of old trees brownish and deeply divided into narrow rounded ridges, covered with appressed scales.

Young shoots greyish in colour and covered with short stiff pubescence. Leaves pectinately arranged, the shorter ones on the upper side of the shoot; those on the median line above pointing forwards, appressed to the twig, and displaying their white under surfaces. They are ⅓ to ⅔ inch long, linear, usually broadest towards the base and tapering to the apex, which is rounded or acute; distinctly and sharply serrulate in margin; dark green above with a median groove often not continued to the apex; lower surface with distinct midrib and two narrow well-defined white stomatic bands, the edges being pure green in colour. Buds brown, ovoid, pointed; scales ciliate, pubescent, keeled, acute.

Cones, ½ to ¾ inch long, ovoid, on slender puberulous stalks nearly ¼ inch long, composed of five series of scales, with about five scales in each series. Scales orbicular oblong, nearly as broad as long, entire and slightly bevelled in margin, striate, glabrescent in the exposed part. Bract small, concealed, lozenge-shaped. Seed with an oblong wing, decurrent half-way on its outer side. The seed with wing about two-thirds the length of the scale.

VARIETIES

A considerable number of horticultural varieties are known, no less than fourteen being described by Beissner. Some of these are variegated forms, as var. *argentea* or *albo-spica*, in which the tips of the young shoots are whitish. Others differ in habit and stature, as var. *pendula*, with pendulous branches, and var. *Sargentii*,[1] a flat-topped bushy form of compact habit with short pendulous branches. The latter was found about forty years ago on the Fishkill Mountains in New York, and was first cultivated and made known by Mr. H. W. Sargent. One of the original plants, growing on the Howland estate, in Matteawan, New York, is now about 25 feet across. Grafted plants of this variety form in a few years an erect stem, and lose the dense low habit which is the charm of the original seedlings.[1]

Var. *parvifolia*, as cultivated at Kew, is a shrub, with stout branchlets, and very short leaves, about ¼ inch long, which spread radially outwards from the shoot.

(A. H.)

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[1] Sargent, *Garden and Forest*, x. 490 (1897).

Distribution

In the colder parts of New England and Canada the hemlock is one of the most characteristic trees of the virgin forest, and extends, according to Sargent, from Nova Scotia and New Brunswick westward through Ontario to eastern Minnesota, southwards through Delaware, southern Michigan, and central Wisconsin, and along the Appalachian Mountains to north-western Alabama. He says that it attains its largest size in the south, in the mountain valleys of North Carolina and Tennessee, and gives its size as usually 60 or 70 and occasionally 100 feet in height, with a trunk 2 to 4 feet in diameter; but Pinchot and Ashe (*loc. cit.* p. 134) give 110 feet with a diameter of 6 feet as its extreme size, with a beautiful picture of it (pl. xix.). When, however, I was at Ottawa in September 1904 I visited, in company with Mr. James M. Macoun of the Geological Survey, a forest near Chelsea, in the Gatineau valley, where several hemlocks of nearly 100 feet were standing, mixed with birches, maples, and other hardwoods, and found a fallen tree which must have been at least 125 feet, and perhaps 135 feet long, though the top was too rotten to follow it out to the end. Mr. Macoun, however, said he had never seen one so large before.

It often grows on rocky ridges, where it forms dense groves on the north side, and loves the steep banks of river gorges. Henry visited in 1906 Pisgah Mountain, near Hinsdale, in New Hampshire, where there remain on the estate of Mr. Ansell Dickinson about 700 acres of virgin forest. This mainly consists of a mixture of hemlock and hardwoods, with white pine occurring here and there singly and in small groups; though on one or two areas of a few acres the white pine and hemlock form a pure coniferous stand. The largest hemlock seen measured 113 feet by 7 feet 10 inches, with a clean stem of only 30 feet, being much branched though densely crowded by other trees. A great many small hemlocks throughout the forest formed an undergrowth, and had been suppressed in growth, one which was ¾ inch in diameter and 10 feet high showing 65 annual rings.

In the Arnold Arboretum, near Boston, is a fine natural grove of this tree, called Hemlock Hill, which gives a very good idea of its normal growth in New England. The average height here is 60 to 70 feet by 3 to 4 feet, and the best that I measured at the bottom of the hill was 80 feet by 4 feet 6 inches. These trees were rather crowded, and had clean boles for 15 to 30 feet up.

The growth of the tree is very slow, and Sargent says that the specimen of its timber in the Jessup Collection in the American Museum of Natural History at New York (which is the most complete that has ever been formed of the woods of any country) is only 13½ inches in diameter inside the bark, though it shows 164 annual rings, of which the sapwood, 2 inches thick, has twenty-nine.

It seeds freely, but the seedlings do not germinate well in the open or on land which has been recently burned over, and seem to succeed best on a mossy stump or fallen log, where they must often remain eight to ten years before their roots reach the earth. According to Sargent they are only three or four inches high at four years old, under favourable conditions, and are easily destroyed.

CULTIVATION

Though introduced by Peter Collinson about 1736,[1] and at one time planted in almost every garden as an ornamental tree, the hemlock is rarely seen in Europe in a condition to remind the American of it as he knows it at home. Of late years it has been superseded by more modern and faster growing introductions.

I cannot exactly say what are the conditions which suit it best in this country, because I have not seen it planted in the shady, damp, and rocky gorges which it likes at home; but a deep light soil, free from lime and well drained, and a northern aspect, seem to suit it best in gardens. Its graceful habit and perfect hardiness should recommend it to all lovers of trees. It has a general tendency to fork near the ground, and this can only be checked by crowding it when young, or perhaps to some extent by careful pruning, as Loudon says that it bears the knife well, and is used for hedges in American nurseries; though I should consider either common spruce or arbor vitæ much better suited for the purpose here.

It ripens seed freely, but the plants I have raised were so small that frost and March winds destroyed them before I learned the necessity of protecting them; and in future I would imitate nature, and sow them on a mossy piece of half-rotten wood, or in a mixture of sand and leaf mould in a shaded frame.

REMARKABLE TREES

By far the most remarkable specimens of this tree which exist in England, or, as I believe, in Europe, are at Foxley, Herefordshire, the seat of the Rev. G. H. Davenport, which are believed to have been planted by Sir Uvedale Price, who was once the owner of this place. He was born in 1747, and died in 1828. In Nash wood, about half a mile from the house, on a rich soil of old red sandstone formation, in a dell facing south-west, a number of these trees are growing, which, though not quite so large as the tree at Studley, average about 55 feet high by 8 to 10 in girth, and although their trunks are not so straight and clean as in an American forest, are nearly all sound and healthy. I measured twenty of these trees in July 1906 and found the largest, the only one which was forked near the ground, to be 10 feet in girth. Another was 9 ft. 10 in., and had a trunk which would contain from 120 to 130 cubic feet. The others ranged from 7 to 9½ feet at 5 feet from the ground, averaging over 8 feet, and were mostly clear of branches, or nearly so, for 15 to 30 feet from the ground. The dense shade of these trees keeps the soil quite free from vegetation below them, but I saw no seedlings in the grove. Though Mr. Davenport was good enough to have a considerable clearing made in order to get a better view of the trees, and Mr. Foster went to Foxley on purpose to photograph them, the difficulty of the subject was so great that the prints taken (Plate 70) do not show them as well as I could wish.

The largest tree which I have seen in England is at Studley Royal, not far below

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[1] A tree said to be the original one planted by him at Mill Hill still survives, but was, when I saw it in 1906, in poor condition, the soil being too dry for it.

Fountains Abbey, and close to two very tall spruce. This, though hard to measure correctly owing to its crowded position, which makes a satisfactory illustration impossible, is over 80 feet high and 11 feet in girth, but is forked at about 7 feet from the ground.

The next best is at Strathfieldsaye, a very spreading tree in damp soil, also forking near the ground. The two stems measure 9 feet 6 inches and 8 feet 3 inches, and the height in 1903 was about 75 feet, the branches weeping to the ground on all sides (Plate 71). At Althorp there is a fine old specimen on the lawn, of a more upright type, which in 1903 was 63 feet by 8 feet 10 inches. At Walcot, in Shropshire, the seat of the Earl of Powis, is one of the best grown trees I have seen, with a bole about 25 feet high, and measuring 60 feet by 8 feet 8 inches. At Mr. Heelas' residence, near Reading, part of the old White Knights estate, is a tree, probably planted 150 years ago, which Henry in 1904 found to be 67 feet by 8 feet. At Arley Castle there is a fine tree dividing into three stems, of which the largest is 6 feet 7 inches in girth and nearly 70 feet high.

At Hardwick, Bury St. Edmunds, there is a tree, forked at 30 feet up, 60 feet by 5 feet 10 inches. At Beauport, Sussex, a tree measured in 1904, 65 feet by 7 feet. At Osberton, Notts, the seat of Mr. F. Savile Foljambe, there is a remarkably spreading old tree about 42 feet high, and dividing near the ground into three stems, each about 6 feet in girth. It has some layered branches which are over 20 feet high, and the total circumference is no less than 80 paces. Bunbury, *Arboretum Notes*, p. 140, mentions as the largest hemlock in the country one growing at Bowood, Wiltshire, the seat of the Marquess of Lansdowne, which, however, cannot now be found.

In Scotland, where the tree should succeed well, I have seen none of great size, except the tree at Dunkeld, which is growing in a thick wood of conifers mixed with beech on rocky ground, close to the Hermitage bridge. This is mentioned by Hunter as being 80 feet high by 10 feet in girth. Mr. D. Keir twenty years later made it 85 feet by 11 feet, and when he showed it to me in 1906 I found that, though the top is not easy to see, it is probably as much as 90 feet, and looks as if it would grow taller. It divides at about 12 feet into several stems, and is believed to be 140 to 150 years old.

At Dalkeith there was in 1891 a tree 42 feet high by 10 feet 6 inches in girth; and at Buchanan Castle, Stirlingshire, the seat of the Duke of Montrose, one measuring 45 feet by 6 feet 10 inches.[1]

In Ireland the largest known to us is one at Carton, the seat of the Duke of Leinster, which in 1903 was 45 feet by 6½ feet.

TIMBER

Opinions as to the value of this wood differ a good deal, and I have no personal experience in the matter. Sargent says that it is light, soft, not strong, brittle, coarse, crooked-grained, difficult to work, liable to wind-shake and splinter, and not durable when exposed to the air; but that it is now largely manufactured into coarse lumber for the outside finish of buildings, and is also used for railway ties and water-pipes. James M. Macoun, in *The Forest Wealth of Canada*, p. 82, says: "Though little inferior to white pine as rough lumber, a prejudice has for a long time existed against this wood, which is only now dying out. As a coarse lumber it to-day commands almost as high a price as pine. It is one of our best woods for wharves and docks, and great quantities are used annually for piles." It is not, so far as I can learn, imported into Europe. The value of its bark, however, for tanning heavy leather has long been known, and it is used more largely than any other in Canada and the Eastern States of America, often mixed with oak bark in order to modify the red colour of the leather tanned with it alone.[1]

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[1] *Journ. R. Hort. Soc.* xiv. 520, 544 (1892).

Canada pitch, made from the resin of this tree, and oil of hemlock, distilled from its twigs, were formerly used to some extent in medicine, but are not now of any commercial importance. (H. J. E.)

TSUGA CAROLINIANA, Carolina Hemlock

Tsuga Caroliniana, Engelmann, Coulter's *Bot. Gazette*, vi. 223 (1881); Sargent, *Gard. Chron.* xxvi. 780, fig. 153 (1886), *Silva N. Amer.* xii. 69, t. 604 (1898), and *Trees N. Amer.* 49 (1905); Kent, Veitch's *Man. Coniferæ*, 466 (1900).

A tree attaining in America 70 feet in height with a girth of 6 feet. Bark reddish brown, and deeply divided into broad, flat, connected scaly ridges. Young shoots shining grey, with scattered short pubescence in the furrows between the glabrous leaf-bases. Leaves pectinately arranged, those on the upper side of the branchlet shorter than the others, ¼ to ¾ inch long, linear-oblong, uniform in breadth or slightly narrowed towards the rounded apex, which is occasionally minutely emarginate; dark green and shining above, with a median groove either continued up to the apex or falling short of it; lower surface with distinct midrib and two narrow, well-defined white stomatic bands, the edges being green; margin entire. Buds reddish brown, ovoid, sharp-pointed; scales indistinctly keeled and pubescent.

Cones on short stout stalks, pendulous or deflected, cylindrical-oblong, 1 to 1½ inch long, consisting of five series of scales, five scales in each series. Scales oblong-orbicular, rounded and slightly narrowed at the apex, pubescent externally, edge thin and bevelled. Bract concealed, wedge-shaped at the base, rounded at the apex. Seed with a long wing, which is decurrent half-way down its outer side.

Tsuga Caroliniana appears to be the American representative of *Tsuga*

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[1] Prof. H. R. Procter of the Leather Industries Department of Leeds University, tells me that though the bark is still the principal tanning material of North America, it has been cut so recklessly that in many districts the supply is now insufficient, and is supplemented by extracts of other materials, especially that of Quebracho wood (Loxopterygium). In England its use was at one time considerable, but it is no longer a specially cheap material, and its colour has now to a large extent prevented its employment. The bark appears to contain from 8 to 12 per cent of a catechol tannin, yielding large quantities of insoluble "reds," and in this respect it is very inferior to the bark of the common spruce fir, which is largely employed in Austria, though it does not seem to be used in England.

diversifolia, and is remarkable for its limited distribution. It occurs at elevations of 2500 to 3000 feet, usually on dry rocky banks of mountain streams along the Blue Ridge, extending from south-western Virginia through South Carolina to northern Georgia. Sargent states that it occurs either in small groves or mingled with other species, and describes it as a beautiful tree of compact pyramidal habit, with dense dark-green lustrous foliage. Elwes saw it on the Blue Ridge in 1893, and brought home young plants, which, however, died in a year or two.

This tree was discovered in 1850 by Professor L. R. Gibbes. It was first raised in the Arnold Arboretum in 1881, and has proved there quite hardy. It was introduced from thence to England in 1886. There are two or three small specimens in the collection at Kew which are three or four feet in height and have a bushy, spreading habit. This species, judging from the slow rate of growth at Kew, is not likely to attain to timber size in England, and we know of no trees of any size living in this country. (A. H.)

TSUGA BRUNONIANA, Himalayan Hemlock

Tsuga Brunoniana, Carrière, *Traité Conif.* 188 (1855); Hook. f., *Gard. Chron.* xxvi. 72, fig. 14 (1886), and *Flora Brit. India*, v. 654 (1888); Masters, *Gard. Chron.* xxvi. 500, fig. 101 (1886); Kent, Veitch's *Man. Coniferæ*, 462 (1900); Gamble, *Man. Indian Timbers*, 718 (1902); Brandis, *Indian Trees*, 693 (1906).

Tsuga dumosa, Sargent, *Silva N. Amer.* xii. 60 (1898).

Pinus dumosa, D. Don, *Prod. Fl. Nepal.* 55 (1825).

Pinus Brunoniana, Wallich, *Pl. Asiat. Rar.* iii. 24, t. 247 (1832).

Abies Brunoniana, Lindley, *Penny Cyclop.* i. 31 (1833).

Abies dumosa, Loudon, *Arb. et Frut. Brit.* iv. 2325 (1838), and Brandis, *Forest Flor. N.W. India*, 527 (1874).

A tree forming in the Himalayas, according to Hooker, a stately blunt pyramid, with branches spreading like the cedar, but not so stiff, and drooping gracefully on all sides, attaining 120 feet in height and 28 feet in girth. In cultivation in England it assumes a bushy habit, and never makes a clean stem, the trunk being concealed by the dense pendulous branches.

Bark thick and rough. Branchlets light brown in colour with a short and not very dense pubescence. Leaves long, 1 to 1¼ inch, narrow linear, gradually tapering towards the acute and recurved apex, serrulate in margin; upper surface dark green and deeply grooved; lower surface silvery white, the bands of stomata extending almost to the margins. Buds globose, flattened on the top; scales ovate, acute, pubescent.

Cones sessile, ovoid, an inch long, composed of about twenty-five woody scales, which are nearly orbicular, vertically striate, shining, showing externally a thickened ridge a little distance from and parallel to the thin entire margin; bract concealed. Seed two-thirds the length of the scale, with an oblong-ovate wing, which is decurrent on the outer side of the seed to its base.

Tsuga Brunoniana occurs in the Himalayas, from Kumaon to Bhotan, at altitudes varying from 8000 to 10,500 feet. Franchet considers that certain Chinese specimens constitute a distinct variety of the species, which he has named var. *chinensis.*[1] These were collected in N.E. Szechuan by Père Farges, and in the mountains of western Yunnan at 9000 feet altitude by Père Delavay. Diels[2] also identifies with this variety specimens collected by Von Rosthorn in Szechuan. I have seen no Chinese examples, and Mr. E. H. Wilson considers that there is only one species of Tsuga in the mountains of Szechuan, which is *Tsuga chinensis*, Masters. Small plants of the Chinese Tsuga are now in cultivation at Coombe Wood; and are as yet too young to entitle us to speak definitely concerning its affinities. (A. H.)

In the interior of Sikkim I saw this beautiful tree in great perfection in the same forests where Sir Joseph Hooker so well describes it,[3] during my journey with the late W. E. Blanford to the Tibetan frontier in 1870. It occurs first in the Lachen valley at about 8000 feet in an extremely moist summer climate, where snow lies for two or three months in winter, growing in company with *Picea Morindoides*, *Abies Webbiana*, and, higher up, with *Larix Griffithii*, in a forest unrivalled in the temperate region for its botanical and zoological wealth; where it commonly attains a height of 100 to 120 feet. Afterwards, on the path from Lachoong to the Tunkralah, I saw even grander specimens, one of which, as measured by Sir J. Hooker, was over 120 feet high by 28 feet in girth. In these almost pathless forests it is covered with ferns and lichens and forms a graceful pyramidal tree with very drooping branches, and reaches an elevation of about 10,000 feet. On the outer ranges it is not so large, but extends into Bhotan, where Griffith found it from 6500 to 9500 feet. It probably occurs throughout Nepal and in the N.W. Himalaya, as far west as Kumaon, where it is a smaller tree and of little economic value, though in Sikkim the bark is used for roofing huts.

The Himalayan hemlock was introduced into England in 1838, according to Loudon,[4] but is rarely seen, except in a stunted state, with several branching stems, and suffering from the absence of sufficient moisture. Like most of the Himalayan conifers, it grows too early and is injured by spring frosts; but in a few favoured districts of Cornwall and Ireland it seems more at home and has attained considerable size and beauty.

The best specimen that I have seen is at Boconnoc in Cornwall, the seat of J. B. Fortescue, Esq. (Plate 72). This tree measures about 53 feet high by 12 feet in girth near the ground, where it branches into several stems, which spread to about 70 feet in diameter. When I saw it in April 1905 it was covered with cones, from which I have raised many young plants.

There is a rather fine tree at Dropmore, planted in 1847, but not so large or healthy as the one described above; and at Beauport, near Battle, Sussex, there is also a fair specimen.

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[1] *Jour. de Bot.* 1899, p. 258.

[2] *Flora von Central China*, 217 (1901).

[3] *Himalayan Journals*, i. 209, ii. 108, etc.

[4] *Encycl. Trees and Shrubs*, 1036 (1842).

At Southampton,[1] in the Red Lodge nursery belonging to Mr. W. H. Rogers, there was a tree twenty-five years old in 1884, about 20 feet high, which bore cones in profusion. At Kew a specimen planted in a sheltered position lived for many years, but ultimately succumbed. Sir Joseph Hooker[2] knew of no good specimen nearer London than one on a south slope near Leith Hill in a very sheltered and well-watered valley.

At Fota, in the S.W. of Ireland, the seat of Lord Barrymore, Henry measured a tree about 40 feet by 4 feet 10 inches in 1904; and there are trees at Kilmacurragh and Powerscourt, in Co. Wicklow, which are about 30 feet high, all of very branching bushy habit, and with several main stems.

Sargent[3] has never seen a specimen in the United States. (H. J. E.)

TSUGA SIEBOLDII, Siebold's Hemlock

Tsuga Sieboldii, Carrière, *Traité Conif.* 186 (1855); Masters, *Jour. Linn. Soc.* (*Bot.*), xviii. 512 (1881); Mayr, *Abiet. des Jap. Reiches*, 59, t. iv. fig. 12 (1890); Kent, Veitch's *Man. Coniferæ*, 472 (1900).

Tsuga Tsuja, A. Murray, *Proc. R. Hort. Soc.* ii. 508, ff. 141-153 (1862).

Tsuga Araragi, Koehne, *Deutsche Dendrologie*, 10 (1893), and Sargent, *Garden and Forest*, x. 491, fig. 62 (1897).

Pinus Araragi, Siebold, *Verhandl. Batav. Genoot. Konst. Wet.* xii. 12 (1830).

Abies Tsuga, Siebold et Zuccarini, *Fl. Jap.* ii. 14, t. 106 (1842).

Abies Araragi, Loudon, *Trees and Shrubs*, 1036 (1842).

A tree attaining in Japan about 100 feet in height and 12 feet in girth, forming in England a small tree with a short bole and a dense crown of foliage, with numerous branches and pendulous branchlets.

Young shoots greyish in colour and quite glabrous. Leaves pectinately arranged, variable in size, the smaller on the upper side of the shoot, some of these being directed outwards at right angles to the general plane of the foliage. They are oblong, uniform in width, ¼ to 1 inch long, shining and dark green above with a median furrow continued to the rounded and emarginate apex; lower surface with green midrib and two narrow well-defined white bands of stomata; margin quite entire. Buds reddish, ovoid, slightly acute at the apex: scales glabrous on the surface, ciliate in margin.

Cones elongated ovoid, on a stalk about ¼ inch long, pendulous or deflected, composed of five series of orbicular scales, which are rounded at the apex and at the base and have a slightly bevelled margin. Bract included, very short and bifid. Seed with a long wing decurrent half-way along its outer side.

This tree has been much confused with the other Japanese species, from which it is very distinct in botanical characters. Koehne's proposed name, *Tsuga Araragi*, is not adopted by us, the name *Sieboldii* being the first one under the correct genus Tsuga. (A. H.)

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[1] Note in Kew herbarium, and Nicholson in *Woods and Forests*, 1884, p. 243.

[2] *Gard. Chron.* xxvi. 72 (1886).

[3] *Garden and Forest*, x. 491 (1897).

TSUGA DIVERSIFOLIA, JAPANESE HEMLOCK

Tsuga diversifolia, Masters, *Jour. Linn. Soc.* (*Bot.*) xviii. 514 (1881); Mayr, *Abiet. des Jap. Reiches* 61, t. xiv. fig. 13 (1890); Sargent, *Garden and Forest*, vi. 495, fig. 73 (1893), and x. 491, fig. 63 (1897); Kent, Veitch's *Man. Coniferæ*, 467 (1900).

Abies diversifolia, Maximowicz, *Mél. Biol.* vi. 373 (1867).

A smaller tree than Siebold's hemlock, which it resembles in habit.

Young shoots pubescent, the pubescence occurring on both the leaf-bases and the intervening furrows. Leaves arranged as in *Tsuga Sieboldii*, but considerably shorter, scarcely exceeding ½ inch in length, oblong, uniform in breadth, shining and dark green above with a median furrow continued to the rounded and emarginate apex; lower surface with green midrib and two narrow well-defined white bands of stomata; margin entire. Buds red, pyriform, flattened above; scales rounded at the apex, minutely pubescent and ciliate.

Cones subsessile, pendent or deflected, ovoid; scales shining, orbicular-oblong, truncate at the base, with edge slightly bevelled and thickened. Bract minute, concealed, rhomboid. Seed with a short terminal wing, which is not decurrent along its side. (A. H.)

DISTRIBUTION OF THE JAPANESE TSUGAS

In Japan I saw both species in their native forests; but so far as I could learn they are not distinguished by the foresters and are both called Tsuga (pronounced *tsunga*). By the Japanese botanists *Tsuga Sieboldii* is termed *Tsuga*, the other species being named *Kuro-tsuga* or *Kome-tsuga*. Of the two, the latter apparently has a more northern range than *Tsuga Sieboldii*. I saw it in the forest round Lake Yumoto at 4000 to 5000 feet elevation, where it is a picturesque and graceful tree of no great size. Both species, however, according to Shirasawa, are found in this district. *Tsuga diversifolia* also occurred high up in the Atera valley. Further south in the Kisogawa valley and at Koyasan I saw *Tsuga Sieboldii*, which at 2000 to 3000 feet attains a large size, growing scattered in mixed forests and not gregariously, like the other species at Lake Yumoto. I measured a tree at Koyasan, which had been felled; it was over 100 feet in height, of which half was free from branches, the butt being about 3 feet in diameter. I estimated it as 250 to 300 years old, though the growth had been so slow that I could not count the rings beyond 150. The wood of this tree, as I was told by the chief priest of the Gemyo-in temple, who was my host at Koyasan, is even better than that of Hinoki (*Cupressus obtusa*); and much of the wood used in building the temple had been Tsuga. Old trees, however, are now so scarce that the timber cannot be obtained in quantity. I bought some beautiful boards cut from it at Osaka, which have a pale yellow colour and very fine wavy figure. The wood is also made into shingles, which are said to last about forty years, and it has lately been used for paper-making. The bark is used for tanning fishing-nets, and the timber sells in Tokyo at thirty-five to forty yen per 100 cubic feet.[1] The growth of the tree from seed is very slow at first as in the allied species.

History and Cultivation

Tsuga Sieboldii was introduced into Europe by Siebold in 1850. Cones both of this species and of *Tsuga diversifolia* were brought from Japan by John Gould Vetch in 1861, and the latter species was sent out under the name *Abies Tsuga*, var. *nana*. Specimens cultivated at Kew as *Tsuga Sieboldii*, var. *nana*, belong to *Tsuga diversifolia*.

Though both species have been introduced long enough to prove their hardiness in favoured parts of the South of England, we have never seen even a moderately large tree, and doubt much if either species will attain timber size in this country. The Japanese hemlocks seem to prefer a light moist rich soil, free from lime, with shade and shelter from cold winds. They will not grow at all on the limestone soil of Colesborne. The best specimen we know is in the garden of Mr. W. H. Griffiths at Campden, Gloucestershire, and is about 15 feet high. It bore cones in 1905.

Sargent[2] says that *Tsuga Sieboldii* is one of the most graceful and satisfactory of the exotic conifers cultivated in American gardens, where it promises to grow to a large size; but in the garden of Mr. Hunnewell at Wellesley, Massachusetts, which I visited in May 1904, I noted that it had been almost killed to the snow line by the exceptionally severe winter of 1903-1904, though it had produced cones in the preceding year.[3] (H. J. E.)

[1] In *Industries of Japan*, 236 (1889), Rein, who did not distinguish between the two species, probably speaking of *Tsuga Sieboldii*, says that the finest specimens seen by him were in the forests of Kin-shima-yama in Southern Kiu-siu, where it grows with *Picea polita*, and equals it in size, attaining 4 to 5 metres in girth. This goes to show that the tree enjoys a warm moist climate.

[2] *Silva North America*, xii. 60.

[3] Beissner states in *Mitt. D. D. Ges.* 1905, pp. 165, 167, that *T. diversifolia* is hardier than *T. Sieboldii*, but both of them grow well in East Friesland, and Mayr says that *T. diversifolia* is hardy at Munich.

JUGLANS

Juglans, Linnæus, *Gen. Pl.* 291 (1737); Bentham et Hooker, *Gen. Pl.* iii. 398 (1880).

Deciduous trees with furrowed bark. Twigs with chambered pith. Buds scaly, the lateral buds often extra-axillary or accompanied by superposed accessory buds. Leaf-scars large with three groups of bundle-traces. Leaves large, alternate, compound, imparipinnate; leaflets opposite, entire or serrate. Stipules absent.

Flowers monœcious. Male flowers numerous in pendulous catkins, which arise singly or in pairs above the leaf-scars of the preceding year's shoot, appearing in autumn and then visible as short cones covered by imbricated scales. Stamens eight to forty, in several series on the axis of a scale, which is five- to seven-lobed, the lobes representing a bract, two bracteoles and two to four perianth-lobes. Connective of the anthers clavate or dilated. Pistillate flowers few, in an erect spike terminating the current year's shoot; each flower with a three- to five-lobed or toothed involucre, composed of a bract and two bracteoles, adnate to the ovary. Inside the involucre is an epigynous and adherent four-lobed or toothed perianth. Ovary one-celled with one basal straight ovule. Style divided into two linear or lanceolate recurved spreading fimbriated plumose stigmas.

Fruit a large ovoid, globose, or pear-shaped drupe, with a fleshy, irregularly splitting husk, formed by the accrescent involucre and perianth. Nut ovoid or globose, thick-walled, longitudinally and irregularly wrinkled, two- to four-celled at the base, indehiscent or separating at last into two valves. Seed two- to four-lobed at the base, with fleshy cotyledons, which remain within the shell in germination.

About thirteen species of Juglans have been described; and there are two or three unnamed and little-known species in tropical South America. Of the described species three[1] confined to Mexico, one[2] a native of the Antilles, and the Californian walnut[3] have not yet been introduced, and will not be dealt with in the following account.[4]

Plate 73 illustrates the leaves, branchlets, and leaf-scars of the species in cultivation.

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[1] *Juglans mollis*, Engelmann; *J. pyriformis*, Liebmann; and *J. mexicana*, Watson.

[2] *Juglans insularis*, Grisebach. Concerning the walnut reputed to occur in Jamaica, *J. jamaicensis*, C. DC., cf. *Kew. Bull.* 1894, p. 371.

[3] *Juglans californica*, Watson.

[4] Since the above was written, Mr. Dode has published a paper containing descriptions of several new species in *Bull. Soc. Dendr. France*, i. 67 (1906); but these seem to us to be founded on variable characters, and to be rather forms due to cultivation.

KEY TO THE SPECIES OF JUGLANS IN CULTIVATION

I. *Leaflets not serrate; usually entire or sinuate* (Plate 73).

1. *Juglans regia*, Linnæus. Bosnia and Greece, through W. Asia and Himalayas to N. China.

   Leaf-scars deeply notched without a pubescent band on their upper edge. Leaflets 7 to 9, glabrous beneath except for inconspicuous axil tufts.

II. *Leaflets serrate. Leaf-scars without a pubescent band on their upper edge.*

* *Leaflets glabrous beneath, except for the axil tufts.*

2. *Juglans regia × nigra.* Two forms: *Juglans Vilmoriniana*, Carrière, and *Juglans pyriformis*, Carrière.

   Leaflets 11 to 13, with fine shallow serrations.

** *Leaflets pubescent beneath.*

3. *Juglans rupestris*, Engelmann. Arizona, Texas, New Mexico, Mexico.

   Leaflets small, 7 to 15, ovate or lanceolate, never oblong, green beneath. Young shoots glandular-pubescent.

4. *Juglans nigra*, Linnæus. Canada and United States, east of the Rocky Mountains.

   Leaflets large, 15 to 19, ovate-oblong with long-acuminate apex, pale beneath. Young shoots glandular-pubescent.

5. *Juglans stenocarpa*, Maximowicz. Manchuria.

   Leaflets large, 11 to 13; all oblong, except the terminal one which is broadly obovate, pale beneath. Young shoots glabrous.

III. *Leaflets serrate. Leaf-scars with a transverse pubescent band on their upper edge.*

6. *Juglans cinerea*, Linnæus. Canada and United States, east of the Rocky Mountains.

   Leaf-scars semicircular, the upper edge straight and scarcely notched. Leaflets, 11 to 13, oblong; serrations fine and directed outwards.

7. *Juglans Sieboldiana*,[1] Maximowicz. Japan, Saghalien.

   Leaf-scars obcordate, 3-lobed, notched above. Leaflets, 13 to 15, oblong; serrations shallow, irregular, directed forwards; base rounded and unequal.

8. *Juglans mandshurica*,[1] Maximowicz. Manchuria, Korea, China.

   Leaflets and leaf-scars practically indistinguishable from those of the last species, though the leaflets are usually longer-acuminate. Fruit, however, remarkably distinct. See detailed description.

9. *Juglans cordiformis*,[1] Maximowicz. Japan.

   Leaf-scars and leaflets closely resembling those of *J. Sieboldiana*, the leaflets, however, fewer (11 to 13) and with a cordate base.

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[1] These three species, though differing remarkably in fruit, are very similar in leaves and shoots.

JUGLANS REGIA, COMMON WALNUT

Juglans regia, Linnæus, *Sp. Pl.* 997 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1421 (1838).

A deciduous tree, attaining 100 feet in height and 15 to 18 feet in girth. Bark smooth and silvery grey in young trees, becoming ultimately more or less deeply fissured.

Leaves large, up to 10 inches long, coriaceous, of five to nine (rarely as many as thirteen) leaflets, sub-opposite or opposite, the terminal leaflet stalked, the others subsessile; elliptic, long-ovate or obovate, shortly acuminate at the apex, tapering and unequal at the base, glabrous on both surfaces, except for inconspicuous tufts of pubescence in the axils of the nerves on the lower surface; dark green above, paler beneath, entire or slightly sinuate in margin; exhaling an aromatic odour. Venation pinnate, with ten to fourteen pairs of lateral nerves, which run nearly straight to near the margin, where they curve forwards and join with the next vein. The leaflets diminish in size from the apex to the base of the leaf. Rachis glabrous, terminal leaflet not articulated. Young shoots glabrous, with yellow sessile glands and white inconspicuous lenticels.

Male catkins arising singly or in pairs (one above the other) above the leaf-scars of the previous year's shoots, green, two to five inches long, sessile, pendulous, thickly cylindrical and densely flowered; flowers with stalked bracts, two to five perianth leaves and two bracteoles; stamens ten to twenty; anthers oblong, apiculate. Female flowers, one to four, at the apex of the young shoots, green, with usually purple stigmas; involucre minute, indistinctly four-toothed; perianth green, with four linear-lanceolate divisions.

Fruit globular, about two inches in diameter; pericarp green, smooth, glandular-dotted, coriaceous, and very aromatic, splitting irregularly when mature. Nut very variable in shape, wrinkled and irregularly furrowed, thin- or thick-shelled; divided interiorly by two thin dissepiments into four incomplete cells; one dissepiment separating the two cotyledons, the other dissepiment dividing them into two lobes. The structure of the fruit of the walnut is very complicated, and the reader is referred for further details to Lubbock's paper[1] on the fruit and seed of the Juglandeæ.

The common walnut, according to Kerner,[2] is truly monœcious, the stigmas, however, ripening several days before the pollen is shed from the anthers.[3] The unripe male catkins have the flowers crowded together in a short thick spike directed upwards. As soon as the pollen develops the spike elongates to three or four times its former length and becomes loose and pendulous, the flowers separating from one another. The pollen then falls into a depression on the side of the neighbouring flower below, from which it is shaken out by the wind and carried to neighbouring branches of the tree, where it alights on the stigmas of the female flowers.

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[1] *Jour. Linn. Soc.* (*Bot.*), xxviii. 247 (1890). Cf. also Lubbock, *Seedlings*, ii. 506 *seq.* (1902). Malformed walnuts are occasionally produced, which are very curious. Cf. *Gard. Chron.* 1858, p. 5, and 1890, viii. 758, fig. 154.

[2] Cf. Kerner, *Nat. Hist. Plants*, Eng. trans. i. 742, fig. 184 (1898).

[3] This is not invariable. Delpino observed that while certain trees of the common walnut were protogynous, *i.e.* the stigmas ripening first, other trees were protandrous, the stigmas ripening after the anthers. In such cases the trees behave as if they were diœcious. Cf. Darwin, *Diff. Forms of Flowers*, 10 (1877), and Trelease, *Missouri Bot. Garden Report*, vii. 27 (1896).

SEEDLING[1]

The cotyledons are large, fleshy, obovate, bi-lobed and crumpled, filling the cavity of the seed, from which they do not emerge on germination, but remain underground. The primary root makes its exit by the apex of the nut, and becomes stout and flexuose, giving off a few lateral fibres. The caulicle is very short, stout, and woody. Young stem, erect, compressed, glabrous, greenish, and covered with lenticels. The first four pairs of leaves are mere scales, opposite or sub-opposite on the stem. The ninth leaf is foliaceous, and consists of three leaflets, the terminal one large, obovate or elliptical, and cuspidate, the lateral ones small, oblong and alternate. The next leaf is five-foliolate; the terminal leaflet, oblong-obovate; the middle pair ovate, acuminate, oblique at the base, unequal, and sub-opposite; the basal pair small, ovate, oblique, and unequal. The last leaf is like it, or bears only four leaflets. All these primary leaflets are serrate in margin, and more acuminate than those of the adult plant, which are entire. In these respects they resemble the adult leaves of Carya or other species of Juglans.[2]

IDENTIFICATION

The common walnut is distinguishable in summer from all the other species by its glabrous, entire, few leaflets. In winter the following characters are available:— Twigs stout, glabrous,[3] shining, greenish or grey, with scattered longitudinal lenticels. Leaf-scars on prominent pulvini, broadly obcordate, the upper margin deeply notched in the centre and not surmounted by a band of pubescence; bundle-dots in three groups. Pith large, white or buff in colour, with wide chambers. Terminal bud ovoid, obtuse at the apex, with four external grey tomentose scales in two valvate pairs, the scales not lobed at their apex and merely representing leaf-bases. In many cases, as in slow-growing old trees, the true terminal bud is aborted on most of the branchlets, and its scar marks the end of the twigs. Lateral buds small, arising at an angle of 45°, globose, the two outer scales usually concealing the inner ones, pubescent at first, but ultimately becoming glabrous. Superposed lateral buds occur only rarely.

VARIETIES

Two distinct geographical forms are known:—

(*a*) *typica*, in Europe, Asia Minor, Persia, and the Himalayas. Leaves elliptic; nuts ovoid-globose with thin septa.

(*b*) *sinensis*, C. DC. in *Ann. Sc. Nat.* 4 Sér. xviii. 33, figs. 38, 39. North

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[1] Cf. Lubbock, *Seedlings*, ii. 516, fig. 661 (1902).

[2] Cf. Fliche, *Bull. Soc. des Sciences*, Nancy (1886).

[3] Some varieties of cultivated walnuts have the twigs covered with a minute pubescence.

China and Japan. Leaves oval or ovate. Nut globose, scarcely apiculate at the apex, sparingly wrinkled; septa thick and bony.

A large number of varieties have arisen in cultivation.

1. Var. *pendula*. Tree, pendulous in habit.

2. Var. *præparturiens*. A bushy shrub, producing fruit at an early period, sometimes when only two or three years old. According to Carrière[1] it was obtained from seed by Louis Chatenay, a nurseryman at Doué-la-Fontaine, about the year 1830, the first mention of it being in *Ann. Soc. d'Hort. Paris*, 1840, p. 741. M. Chatenay found in the midst of a number of seedlings of walnuts three years old a single individual which bore fruit. This variety was put into commerce by M. Janin of Paris. According to Carrière, when the seeds of it are sown, different forms are produced, from young plants which bear fruit in their second year up to others which only produce fruit at an advanced age. The plants are also variable in size. The nuts are generally thin-shelled and small, but good in quality.

3. Var. *præcox*. Comes into flower and fruit a fortnight earlier than the common kind.

4. Var. *serotina*, Desfontaines. This variety flowers very late, and is recommended in localities liable to spring frosts. It is said[2] that of this variety, when sown, only three per cent came true, and flowered late in the season.

5. Var. *monophylla*. Leaves simple or trifoliolate. A small tree of this kind, which bears both simple and trifoliolate leaves, the basal pair of leaflets being very small, is growing at Bayfordbury, the residence of Mr. H. Clinton Baker.

6. Var. *rotundifolia*. Leaflets oval.

7. Var. *serratifolia*.[3] Leaves serrate. There is a specimen in the Kew herbarium from a tree in Germany, all the leaves of which were distantly serrate in margin. The leaves of young seedlings are always serrate; and this juvenile character is often retained in some walnut trees up to a considerable age.

8. Var. *laciniata*, Loudon. Leaves very deeply cut. The foliage of this variety is light and feathery, much more so than that of the common walnut, and is retained till late in the autumn. A fine specimen was reported in 1884 to be growing at Bicton.[4] Elwes has seen only three trees of this form, of which the largest, growing on a lawn at Westonbirt, was 30 to 40 feet high. Another was at Melbury, and a third, of no great size, at Poltalloch in Argyllshire.

9. Var. *heterophylla*. Leaflets variable, some of the ordinary form, others irregularly cut.

10. Var. *variegata*.[5] Leaflets with white margins.

11. A tree was growing in 1890 at Chawton Park, Alton, Hampshire, of which specimens with extremely narrow leaflets were sent to Kew.

The number of varieties of the walnut in cultivation, as regards the shape, colour, and other qualities of the fruit, is very great; but a detailed description of these does not come within the scope of our work. The most remarkable is the huskless walnut[1] of North China, which is cultivated in the mountains to the north-west of Peking. In this curious form the husk is almost wanting, being very thin and irregular. In var. *racemosa* the fruits are numerous, fifteen to twenty-four, and are set close together on the peduncle. In var. *maxima*, Loudon (var. *macrocarpa*), the fruits are very large. The nuts are elongated and very narrow in var. *elongata* (var. *Bartheriana*[2]); very sharp-pointed at both ends in var. *rostrata*; and have very thin shells in var. *tenera*,[3] Loudon (var. *fragilis*). The kernel of the nut is bright red in var. *rubra* (var. *rubrocarpa*).[4]

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[1] *Rev. Hort.* 1882, p. 419.

[2] *Gard. Chron.* 1883, xx. 114. See *Rev. Hort.* 1861, p. 430, fig. 108. Called St. John's Walnut, as it does not put forth leaves till Midsummer or St. John's Day, in Parkinson's *Theatrum Botanicum*, 1414 (1640).

[3] The serrate-leaved walnut is mentioned by Parkinson, *loc. cit.* 1413.

[4] *Woods and Forests*, 1884, pp. 164 and 512. See also concerning this variety *L'Horticulteur Français*, 1862, p. 47.

[5] *Rev. Hort.* 1861, p. 429, fig. 104.

Hybrids

I. *Juglans regia* × *nigra*. Two forms of this are well known in cultivation; they differ mainly in the character of the fruit.

1. *Juglans Vilmoriniana*, Carrière, *Rev. Hort.* 1863, p. 30. Young shoots glabrous. Leaf-scars obcordate, three-lobed, deeply notched above. Leaflets eleven to thirteen, ovate-lanceolate, sub-sessile, apex acuminate, base rounded or tapering; serrations fine and shallow, directed forwards; lower surface green and glabrous, except for conspicuous tufts of pubescence in the axils of the main veins. Rachis glabrous in the upper leaves of the shoot, pubescent towards its base in the lower leaves. Fruit with the thick husk of *J. nigra*. Nut smooth, globose, thicker shelled and more deeply furrowed than that of the common walnut.

In *Garden and Forest*, iv. 51 (1891), M. M. de Vilmorin gives particulars of the original tree in his garden at Verrières les Buisson, near Paris, and an excellent illustration of it in winter. He says that it was planted about 86 years previously as a young seedling by his grandfather as a memorial of the birth of his eldest son. Nothing certain is known of its origin, though it was supposed by Dr. Engelmann to be a hybrid, between the European and the black walnut. The characters of the bark, branchlets, and buds are intermediate; the leaves resemble those of *J. regia* more than those of *J. nigra*. The fruit, which is not produced every year, and never in quantity, is figured, and resembles most that of the black walnut. Of the few seedlings which have been raised from it one is growing beautifully in the Arboretum at Segrez, and produces fertile nuts. All the seedlings have grown well when planted in deep sandy soil mixed with clay. The tree at Verrières was seen by Elwes in 1905, and measured 95 feet high by 10 feet in girth, with a bole about 16 feet long. The habit of the tree was considered by him to resemble the black walnut rather than the common species.

There are young trees of *J. Vilmoriniana* growing at Kew, and one has been recently sent to Colesborne by M. de Vilmorin.

2. *Juglans pyriformis*, Carrière, *loc. cit.* 28, figs. 4 to 9. *Garden*, L. 478, fig. (1896).

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[1] See Hance, in *Journ. Bot.* 1876, p. 50.

[2] Figured in *Garden*, L. 478 (1896); and *Rev. Hort.* 1859, p. 147, and 1861, p. 427.

[3] The thin-shelled walnut is mentioned in Parkinson, *Theatrum Botanicum*, 1413 (1640).

[4] See *Gard. Chron.* xxiii. 346 (1898). This variety is figured in *Wien. Illust. Gart. Zeitung*, 1898, p. 165.

Carrière states that this tree arose from a cross between *J. regia* and *J. nigra.* The leaves are identical with those of *J. Vilmoriniana.* The young shoots differ in having a glandular pubescence. The fruits are long-stalked and pear-shaped, but otherwise closely resemble those of *J. nigra.* Young trees of this kind are in cultivation at Kew.

3. Other hybrids between these species have been described. One mentioned by Sargent was an immense tree, found in 1888 by Prof. Rothrock on the Rowe Farm on the north bank of the Lower James River, Virginia. It is described as having the habit, foliage, and general appearance of *J. regia*, but producing a nut not unlike that of the black walnut, though longer and less deeply sculptured. The nut is exactly like that of *Juglans regia gibbosa*, Carrière,[1] which was raised by a nurseryman at Fontenay-aux-Roses in 1848.

De Candolle also described,[2] as *Juglans regia intermedia*, a tree which was found at the Trianon, and supposed to be a cross between the common and black walnuts. M. C. de Candolle informed Elwes that a similar hybrid exists at Geneva, and that its seedlings have characters intermediate between the two parents.

There are specimens at Kew, which were sent by Mr. E. Lyon in 1901 from Hurley, Marlow, where there is a fine old tree of *Juglans nigra*, from the seed of which plants were raised, which are apparently intermediate between that species and the common walnut.

II. *Juglans regia* × *cinerea.* *Juglans alata*, Carrière,[3] *Rev. Hort.* 1865, p. 447. This is described as having young shoots pubescent: leaflets seven to nine, with the end leaflet stalked, the others subsessile; all oval or elliptic-lanceolate, abruptly acuminate, obscurely and remotely serrate, pubescent on both surfaces: rachis shortly pubescent. Three trees, presumably of this hybrid, have been observed near Boston in the United States; and a description and figure of them are given in *Garden and Forest*, 1894, p. 435, fig. 69.

III. *Juglans regia* × *californica.* A remarkable hybrid between the common walnut and the Californian wild species, has been obtained by Luther Burbank, who names it "paradox."[4]

DISTRIBUTION

The common walnut has a very wide distribution, occurring wild in Europe in Greece, Bosnia, Servia, Herzegovina, Albania, and Bulgaria; and extending eastward through Asia Minor, the Caucasus, Persia, and the Himalayas to Burma and North China and Japan. Its occurrence as an indigenous plant in Greece was first demonstrated by Heldreich,[5] who found it growing wild in Ætolia at Korax, in Phthiotis on the Œta and Kukkos mountains, and in Eurytania on Veluchi, Chelidoni, etc. It grows wild in Greece in mixture with oaks and chestnuts in great quantity, especially in the moister valleys and ravines up to the region of the silver fir, at altitudes varying between 2200 and 4300 feet. Small woods of walnut, undoubtedly wild,[1] occur in Bosnia and Servia, especially on the north slopes of mountains rich in springs. It ascends in Herzegovina to 2400 feet, in southern Servia to 1400 feet, and in Albania to 2200 feet. Velenovsky[2] considers it to be truly wild in the Rhodope mountains. According to Radde[3] it occurs in the Caucasus, from the sea-level to 4500 feet altitude; also in Ghilan in North Persia. According to Meakin,[4] it is met with wild in the mountains not far from Bokhara. There are wild specimens at Kew from Armenia. According to Aitchison it is wild in Afghanistan, at 7000 to 9000 feet, and also in the Kuram valley. It occurs in the temperate Himalayas and Ladak, at altitudes of 3000 to 10,000 feet from Kashmir and Nubra eastward. Kurz met with it in the Shan Hills in Burma. It is cultivated throughout China, and appears to be indigenous in North China and Japan;[5] but other species of Juglans are much commoner in the wild state throughout China and Japan.

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[1] *Rev. Hort.* 1860, p. 99, figs. 21-23, and 1861, p. 428, figs. 101-103. Rehder considers this hybrid to be the same as *J. Vilmoriniana.*

[2] *Ann. Sc. Nat. Sér.* iv. xviii. t. 4.

[3] This is probably the same as *Juglans intermedia quadrangulata*, Carrière, *Rev. Hort.* 1870, p. 493, figs. 66-68.

[4] *Garden and Forest*, 1894, p. 436.

[6] *Verhand. Bot. Vereins Prov. Brandenburg*, 150 (1879).

We are indebted to Sir W. Thiselton Dyer for the following:—

"The walnut found its western natural limit in Greece, but early made its way into Italy. Its classical name Juglans is *Jovis glans*, but in poetry it is always *Nux*. Virgil's *ramos curvabit olentes* hits off the acrid smell of the foliage. The nuts were thrown at weddings, as Virgil tells us, *sparge marite nuces*, because, amongst other reasons, Pliny says, they made the maximum of noise.

"*Relinquere nuces* was to put away childish things: so Catullus, *da nuces pueris iners*. The green rind enclosing the nut contains a dye used to darken the hair, the *viridi tincta cortice nucis* of Tibullus, in modern times more often the skin."

The walnut is extensively cultivated in France, Germany (except in the north where it ripens fruit rarely), and throughout southern Europe. It is cultivated chiefly in the region of the beech, as in Hungary up to 2160 feet, on the southern slopes of the Alps up to 3800 feet, in the Vosges up to 2200 feet. In Norway it is grown on the west coast as far north as Trondhjem, where it has reached a height of 30 feet, and in very favourable summers ripens fruit. Many other localities are mentioned by Schubeler, vol. ii. pp. 429-431. In Sweden it exists near Stockholm, and in Scania, at Cimbrishamn (55° 30′), Linnæus measured, in 1749, a tree 60 feet high. (A. H.)

PROPAGATION AND CULTIVATION

If the walnut is wanted as a fruit-bearing tree it is better to procure from a nurseryman grafted or budded trees of some of the large-fruited, thin-shelled sorts, which have been raised in France; and which grow best in the south and east of

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[1] Beck von Mannagetta, *Vegetationsverhält. Illyrischen Ländern*, 219 (1901).

[2] *Flora Bulgarica*, 512 (1891).

[3] *Pflanzenverbreitung in Kaukasusländern*, 170, 182.

[4] *Russian Turkestan*, 23 (1903).

[5] It is included as a wild plant in Japan by Matsumura in *Shokubutsu Mei-I*, 155 (1895); but Sargent in his *Forest Flora of Japan*, p. 60, says, "It is occasionally cultivated in the neighbourhood of temples and as a fruit tree; but we saw no evidence of its being anywhere indigenous, and it is probable that it was introduced from Northern China, where one form of this tree apparently grows naturally."

England. The process of budding or grafting them is fully described by Loudon, p. 1431, and need not be repeated here.

If, however, walnuts are to be planted for timber or ornament, it is far better to raise them from nuts, which may be sown as soon as they are ripe, if they can be protected from mice and vermin; or kept in sand until February, when they should be sown two to three inches deep in rich light soil, which will encourage the production of fibrous roots at an early period. As the large strong tap-root makes the tree difficult to transplant, it should be undercut with a spade about six inches below the soil in the first year, or the nut may be allowed to germinate before sowing and the end of the root pinched off. If this is not done they must be carefully transplanted in March, and protected from late spring frost as much as possible until they have made stems four to six feet high. For though the walnut is one of the latest trees to come into leaf, none is more tender as regards spring frost, and as it does not bear pruning well and has a natural tendency to form branches rather than a clean stem, it is important that the trees should be carefully trained when young.

It is now much less planted than formerly, and the wood is not so much valued by country timber merchants as it ought to be, but there is no reason why it should not be treated as a forest tree on suitable soils, and drawn up among other trees with the object of growing clean timber; though I consider it inferior to the black walnut in this respect. It is evidently a lover of a warm soil and climate, and though on good limestone soil or deep loam resting on chalk it grows fast and to a great size, it should not be planted on heavy clay, on poor sand, or in exposed windy situations.

The walnut is very seldom blown down on account of its strong roots, and I have never seen one struck by lightning. It does not reach a very great age; so far as I know, 200 years is about the limit of its life, and many trees become hollow or decayed before attaining as much as this.

The only place where I have seen walnuts self-sown in England is at Holkham, where, in the Triangle plantation, are several trees, one 17 feet high, in a fairly thick plantation of larch and Scots pine on light sandy soil. They are 100 to 150 yards distant from the parent tree, the nuts having probably been carried by squirrels or rooks. On the sandhills at the same place I saw a self-sown tree five to six feet high, and on the roadside near Colesborne a young tree has sprung up from a nut dropped by a passer-by.

Mr. E. Kay Robinson[1] mentions the occurrence of young walnut trees amidst clumps of other large trees, due to the carrying away by rooks of the fruit from an old walnut tree in a garden near by. He has kindly sent us a photograph of a walnut tree growing in a field at Warham, near Wells, Norfolk, which had evidently been deposited by a rook, as the young tree in its growth had thrust up the roots of an old willow tree, amongst which it had grown.

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[1] *Garden*, lxvi. 412 (1904).

REMARKABLE TREES

Though there are many very fine walnuts scattered through the southern half of England I cannot say where the largest tree actually is. Nothing that I know of now living equals a tree recorded by Mr. W. Forbes,[1] which grew on the estate of Sir Charles Isham at Lamport Hall, Northamptonshire, and was sold to Messrs. Westley Richards, gunmakers of Birmingham. According to the measurements given, this tree contained 816 cubic feet of sound wood, of which the butt, measuring 12 feet by 18 feet in girth, contained 243 feet and one limb 108 feet.

A magnificent tree, said to have been the largest in England, grew at Cothelstone, near Bishops Lydeard, Somersetshire, which Loudon records as being 64 feet high and 6½ feet in diameter,[2] but I am informed by Mr. E. V. Trepplin, agent to Viscount Portman, that it was blown down some years ago.

No tree mentioned by Loudon equals the one of which I give a figure (Plate 74), which grows in front of the house at Barrington Park, near Burford, Oxfordshire, the property of Mr. E. C. Wingfield, on an oolite formation. This tree measured in 1903, 80 to 85 feet in height by 17 feet in girth, and has a fine bole and a very burry trunk. There are two other splendid walnuts in this park nearly as tall and over 15 feet in girth, and others have been cut down of which the timber, when cut up in London, was considered by Mr. A. Howard equal in colour and figure to Italian walnut. At the Moot, Downton, Wilts, the residence of my old friend Mr. Elias P. Squarey, are four fine walnut trees, one of which was said by Mr. D. Watney to be the largest he had seen during his long experience as a valuer, and estimated to contain over 400 feet. It measures 17 feet 2 inches in girth, with a short butt dividing into four big limbs which run up to about 80 feet in height. Another is the tallest walnut I have ever seen or heard of, and measured in 1903 about 100 (perhaps more) feet high by 13 feet in girth.

In the village street of Bossington, Somersetshire, I was shown by Mr. S. F. Luttrell of Dunster Castle, a very picturesque old gnarled walnut tree which at 5 feet is 17 feet in girth, but the roots are so spreading that the trunk, measured close to the ground and following the sinuosities, is 35 feet round. A walnut of apparently no great age in a field at Cobham village in Kent measured in 1905 about 70 feet by 13 feet, and the branches spread over a circumference of 99 paces.

An avenue of walnuts is seldom planted in England, but at Moor Court, Herefordshire, there is a short one which from an illustration in the *Gardeners' Chronicle* of February 6, 1875, seems very effective. They are 60 to 70 feet high and 10 to 12 in girth.

At Sudeley, Gloucestershire, the seat of Mr. H. Dent Brocklehurst, there are in a line before the Castle four beautiful trees of great age, the largest measuring 90 feet by 14 feet, and in Rendcombe Park near the Temple there is a fine old tree about 80 feet by 15 feet whose branches cover an area 105 paces in circumference.

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[1] *Trans. Eng. Arb. Soc.* v. 155.

[2] In *Trans. Eng. Arb. Soc.* ii. 225, measurements of this tree made in 1888 by Dr. Prior are given as follows:—height, 94 feet 6 inches; girth, 18 feet; spread, 22 yards by 27.

At Laverstoke Park, Whitchurch, Hants, the residence of Mr. W. W. Portal, there is a fine well-shaped walnut, which was measured by Henry in August 1905, as 80 feet high by 13 feet 8 inches in girth, with a bole of 12 feet, dividing into two stems above.

In the eastern counties there must be many fine walnuts, but the only one of which I have any exact record is a tree which was figured by Grigor[1] at Ketteringham Park, Wymondham, Norfolk, the seat of Sir M. Boileau, Bart., and is said to have been planted at the restoration of Charles II. This tree was one of the best shaped as regards its branches that has been figured, and measured in 1841 68 feet high with a girth of 12 feet.

At Rickmansworth, Herts, Sir Hugh Beevor measured in 1901 a tree 98 feet high by 11 feet 9 inches in girth, the first limb coming off at 18 feet up, the second limb at 36 feet from the ground. At Gayhurst, near Newport Pagnell, Mr. W. W. Carlile showed me a tree growing on a clayey limestone, which, though of great age, is absolutely sound and has lost hardly a branch. It measures no less than 80 feet by 17 feet, and is very perfect in shape. At Ware Park, Herts, Mr. Baker tells us of a tree 16 feet 4 inches in girth, and this seems to be a district where the walnut comes to great perfection. He showed me another of the thin-shelled French variety growing close to the bank of the Lea at Roxford, which, though much cut by frost, was 16 feet in girth.

At Castle Howard, Yorkshire, there is a large tree in the park near the stables, growing among beech and oak which have drawn it up to a height of 80 or 90 feet, though it leans very much to one side. It has a clean bole about 20 feet long by 11 feet 8 inches, dividing into two long straight clean stems, a very unusual form in this tree.

In Scotland the walnut is not so much at home as in England, but in the warmer parts of the east and in Perthshire it attains considerable dimensions. The best that I have seen myself is a tree at Gordon Castle (Plate 75) which in 1904 measured 60 feet by 10 feet, and is, considering the exposed position and latitude, a remarkable tree. But there must have been a still finer one here in 1881, when Mr. J. Webster, father of the present gardener, recorded in the *Trans. Scot. Arb. Soc.* ix. 63, a tree of equal height and 13 feet 4 inches in girth at 5 feet. Col. Thynne has given me a photograph of a fine tree at Cawdor Castle, Nairnshire, which measures 65 feet by 15 feet 7 inches.

Hunter records several very fine trees in Perthshire as follows: "At Gask the largest tree in the policies is a walnut, a little west of 'The Auld House.' It measures 17 feet 5 inches at 5 feet and then swells to a girth of 21 feet at 8 feet from the ground, and at Blair Drummond there is a fine tree," which Mr. A. Morton, the gardener, informs me is now about 80 feet by 13.

Though the walnut is not uncommonly planted in Ireland, we have seen none remarkable for size. The largest one is reported to be growing at Kilkea Castle in Kildare.

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[1] *Eastern Arboretum*, 279 (1841).

TIMBER

Until mahogany became common in England about the middle of the eighteenth century, walnut was considered the most valuable wood for furniture, carving, and inside work, and on the Continent most of the best old furniture was made from it. Later it became very valuable for gun-stocks, and is still almost the only wood used, for all except cheap guns. Loudon states that during the long wars at the beginning of the last century in France no less than 12,000 trees were cut annually for gun-stocks, which caused it to become very scarce, and in England as much as £600 was paid for the wood of one tree.

Sir W. Thiselton Dyer informs me that when for political reasons the War Office thought it no longer desirable to depend on walnut, which was mostly imported from the Black Sea, he was consulted as to what other wood might be found as a substitute; but though some twenty sorts of colonial woods were sent for trial from the Museum at Kew to the Small Arms Factory at Enfield, none except the black walnut was found to be at all suitable.

The reason for this is that walnut wood does not warp, and can be cut cleanly in any direction to fit the locks and mechanism of the magazine rifle, and is not liable to swell and bind the lock when wet. But it requires a good deal of care in selection and in cutting out the stocks, so that they are not liable to break at the grip; and the best gunmakers in England obtain their stocks ready cut to specified sizes from French merchants who make a *spécialité* of this trade.

Maple wood has been found suitable in Japan, for when I was there during the late war, I saw numbers of roughly shaped gun-stocks of that wood being cut in the forest near Koyasan, and carried out on men's backs to supply the immense demand of the arsenal. But in England it was found to make a rifle stock 4 ounces heavier than walnut, and is also liable to warp.

The late Mr. J. East told me that, in the year 1838, at Missenden in Bucks, four walnut trees were sold in one lot for £200, and about the same time two other trees were sold for £100 each, but the demand is now so much lessened by foreign importations, and by the substitution of other woods, such as mahogany and American walnut, that its average price now is not more than from 1s. 6d. to 3s. per foot.

The wood requires a long time to season thoroughly, and should not be used for good work until three to six years after felling, as it is liable to shrink considerably. It is also liable to be ring shaken, and has another great defect in the fact that the sapwood, which forms a large proportion of most trees, is pale in colour and very liable to be attacked by wood-eating beetles. Almost all the old Italian furniture which I have seen is more or less damaged in this way, and though the sapwood is often stained so as to look like the heartwood, it is better in first-class work only to use the latter.

As a rule English walnut does not show so much of the dark markings as is found in the logs imported from Italy and the Black Sea, and Italian walnut is usually specified by English architects. But I have seen such fine panelling made from English wood alone that I have no hesitation in saying that with careful selection and seasoning, the best effect can be obtained from old trees grown on dry soil in this country; and in a small work on English timber by "Acorn"[1] it is stated that the home-grown timber is harder and more durable than the foreign.

The finest wood as regards colour and pattern comes from near the root, and from the forks in the tree, which, however, are liable to twist if used in the solid, and in order to obtain as much as possible of these figured pieces the tree, if old, should be grubbed, and great care taken in cutting it up into suitable thicknesses for the purpose for which it is wanted. The forked parts should be cut into thin veneers and matched as well as possible. For panelling, walnut comes only second to oak, and is found in some of the best houses in England. As a fine example of Italian walnut panelling I may mention the billiard room at Edgworth, near Cirencester, which was designed for my friend Mr. Arthur James, by Mr. Ernest George. Of modern English walnut panelling I have seen a good example put up in Mr. Franklin's beautiful old house, Yarnton Manor, near Oxford, which he has recently restored, and in which the panelling both of oak and walnut is admirable. The late Mr. Holford of Westonbirt, Tetbury, had his large music-room entirely fitted with walnut cut on his own estate.

A newer system of using walnut wood in large knife-cut unpolished veneers is now adopted by modern decorators, of which a fine example may be seen in the board room of the Royal Insurance Company at Liverpool.

One of the most valuable woods in the world is produced by the burrs or excrescences which are produced on the walnut tree, rarely in England, but more commonly in its native country, and which are sought for by agents travelling for French firms at Marseilles, who seem to have a monopoly of this wood. Sometimes they are very large, measuring two to three feet in diameter, but more usually smaller, and are sold at very high prices, as much as £50 to £60 per ton, according to Laslett. They are called *loupes* in France, and are cut into very thin sheets to cover the very finest pianoforte cases, and much used for cabinet-making. These burrs are said to grow on trees in mountainous and inaccessible regions in Circassia, Georgia, North Persia, and Afghanistan; and I am told by Mr. C. W. Collard that those now imported are not so fine as they used to be some years ago.

I can find no records or measurements of walnuts abroad which show that it ever exceeds in warmer climates the size it attains here; but the largest foreign log which I have ever seen was shown by Messrs. Riva and Massara of Milan at the Exhibition held there in 1906. This log measured about 28 feet long by 15 feet in girth, and was said to contain about 16 cubic metres of timber, equal to about 560 feet. Its weight was 14,800 kilogrammes, and I was informed by the owners that they paid 5800 francs (about £232) for it in Switzerland. But Correvon[2] quotes *La Patrie Suisse* to the effect that a walnut was cut at Bois-de-Vaux, near Lausanne, which required twenty-four horses to haul it. The lower part of its trunk measured about 24 feet, the diameter was 6 feet 4 inches, and the total contents about 700 cubic feet. This butt was sold for £150 to make gun-stocks.

(H. J. E.)

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[1] Published by W. Rider and Son, London, 1903.

[2] *Nos Arbres*, 267 (1906).

JUGLANS NIGRA, Black Walnut

Juglans nigra, Linnæus, *Sp. Pl.* 997 (1753); Loudon, *Arb. et Frut. Brit.* iii. 1435 (1838); Sargent, *Silva N. America*, vii. 121, tt. 333, 334 (1895), and *Manual Trees N. America*, 128 (1905).

A tree attaining 150 feet in height, with a girth of about 15 to 20 feet, forming in the forest a narrow round-topped head, but with spreading branches when isolated. Bark of old trees dark brown, deeply furrowed with broad ridges, which are scaly on the surface.

Leaves up to 3 feet in length, of fifteen to twenty-three leaflets, which are ovate or ovate-lanceolate, long-acuminate at the apex, rounded at the base, sub-sessile, with coarse sharp irregular serrations; upper surface with a very minute and very scattered pubescence; lower surface with numerous glandular and simple hairs. Rachis with yellow glands and scattered glandular hairs. Young shoots with sessile yellow glands and numerous glandular hairs; older shoots pubescent. Leaf-scars obcordate, deeply notched at the apex, without any band of pubescence on their upper edge.

Staminate catkins three to five inches long; scales with six orbicular concave pubescent lobes, and a bract ¼ inch long, which is triangular and tomentose; stamens twenty to thirty. Pistillate flowers, two to five in a spike; involucre laciniate in margin or reduced to an obscure ring below the apex of the ovary; perianth lobes ovate, acute.

Fruit solitary or in pairs,[1] globose or slightly pear-shaped, pubescent, not viscid, yellowish green, 1½ to 2 inches in diameter; nut oval or oblong, 1⅛ to 1½ inch, deeply ridged irregularly, four-celled interiorly at the base, and slightly two-celled at the apex.[2]

Identification

In summer it is readily distinguishable from *J. cinerea* and the Eastern Asiatic species, which have serrate leaflets, by the character of the leaf-scar, which is deeply notched at the apex and without the transverse band above its upper margin, which characterises those species. The long acuminate pubescent leaflets distinguish it from the hybrids *pyriformis* and *Vilmoriniana*. It has much larger leaflets than *J. rupestris*, and cannot be confused with *J. stenocarpa*, which has a broadly obovate terminal leaflet.

In winter the following characters are available:—Twigs stout, reddish brown, glandular-pubescent; lenticels small. Leaf-scars on prominent pulvini, obcordate, deeply notched above, without pubescent band, with three groups of bundle-dots. Pith large, buff-coloured, with wide open chambers. Terminal bud ovoid or conical, grey-tomentose, usually with four external scales visible in two valvate pairs, the scales not lobed at the apex. Lateral buds, arising at an angle of 45°, small, globose, pubescent, with two to three scales visible externally; there are often two buds superposed, the lower one minute and embedded in the notch of the leaf-scar. The reddish-brown pubescent twigs and superposed pubescent lateral buds will distinguish this species from the common walnut.

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[1] A tree at Albury, Surrey, has, however, borne fruit in clusters of three, four, and six, of which specimens are preserved at Kew.

[2] For a detailed account of the fruit, seed, and cotyledons of the species, see Lubbock, *Seedlings*, ii. 517 (1902).

VARIETIES AND HYBRIDS

No varieties are known. The Black Walnut forms hybrids with the common walnut, which have been dealt with under the latter species. Burbank has raised a hybrid, which he calls "Royal," between *J. nigra* and *J. californica.*[1]

Juglans nigra × *cinerea.* A tree supposed to be this hybrid grew in the Botanic Garden at Marburg, and was described by Wender as *Juglans cinerea-nigra* in *Linnæa,* xxix. 728 (1857). (A. H.)

DISTRIBUTION

According to Sargent the black walnut occurs in rich bottom lands and fertile hillsides, from western Massachusetts to southern Ontario, southern Michigan and Minnesota, central and northern Nebraska, eastern Kansas, and southward to western Florida, central Alabama, and Mississippi, and the valley of the San Antonio River, Texas; most abundant in the region west of the Alleghany Mountains, and of its largest size on the western slopes of the mountains of North Carolina and Tennessee, and on the fertile bottom lands of southern Illinois and Indiana, south-western Arkansas, and the Indian Territory.

The black walnut is not only one of the largest deciduous trees throughout a great part of the Middle States, but also one which, until it became too scarce, furnished a great part of the most valuable hardwood. It reached its maximum of size and abundance in the western foothills of the Southern Alleghany Mountains and in the rich, fertile alluvial river bottoms through which the great rivers of Ohio, Indiana, Tennessee, and Kentucky flow, and which were the first homes of the settlers who crossed the mountains towards the end of the eighteenth century, and for a quarter of a century carried on an unceasing warfare with the Indians. These pioneers also waged war against the forest whenever they could spare time, and for many years used the black walnut for fencing and for house-building, because it was an easy wood to split and to work; but they did not foresee that the trees which they destroyed would become one of the most valuable products of their farms, and would in a century be almost extinct as timber trees in many places where they were formerly the commonest.[2]

When I was travelling in the mountains of North Carolina in 1895, I saw but few black walnuts of large size, and met with men who were travelling about purposely to find and buy them in all accessible places. In the North Carolina forestry exhibit at the St. Louis Exhibition in 1904, I saw a walnut log from a tree in Jackson County, Kentucky, over 12 feet long and 52 inches in diameter which had evidently been lying long in the forest, and had been repeatedly burnt over, which produced over 800 cubic feet of timber, and was sold, as I was told, for $800. I heard of another still standing in Kentucky which was valued at $1000.

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[1] *Garden and Forest,* 1894, p. 436.

[2] An interesting account of the war waged against the black walnut by pioneers in Indiana in 1834 is given in *Woods and Forests,* 1884, p. 633.

These great trees are now hardly to be seen except in remote regions where it is impossible to get them out, and when I visited the Lower Wabash Valley in southern Illinois, where Prof. R. Ridgway[1] found the largest deciduous trees in the United States, I did not see one of great size. Dr. J. Schneck, who was my guide and who knows the flora of this region better than anyone, gives in his *Catalogue of the Flora of the Lower Wabash*, the measurements of a tree taken by himself as follows:—Circumference, at 3 feet above the swell of the root, 22 feet; height of trunk to first branch, 74 feet; total height, 155 feet. Prof. Ridgway measured another 15 feet in girth at 3 feet, and 71 feet to the first branch, where the trunk was 3 feet in diameter. Assuming such trees to have measured 12 feet in girth in the middle they would contain 600 to 700 feet of clean timber in the first length alone, and now be worth as much as many acres of the land they grew on would fetch when cleared for agriculture.

But in regions which have colder summers and poorer soil, the black walnut does not attain anything like these dimensions, and I have seen none in New England which equal the best trees in Britain. Emerson[2] speaks of one in the Botanic Garden at Cambridge, Mass., as measuring 6 feet 3 inches at 3 feet from the ground, and the tree which he figures growing near Roslyn was a poor specimen of small size.

In Canada it was once abundant in the rich forests of Southern Ontario, but almost all the old trees have been cut down, and plantations are now being made in various parts of Ontario and Western Quebec, and in Alberta and British Columbia, as well as in many parts of the United States from Kansas to California.

Black walnuts of great size are indeed now so rare that I have been unable to procure a really good photograph of the tree in its native forest, and there is none in Pinchot and Ashe's *Timber Trees of N. Carolina.* These authors say that it bears seed abundantly only every three or four years, and that young seedlings are not common except in low fertile, rather open lands, or in meadows which border streams. The growth is very rapid until the tree has reached a large size; only small trees send up shoots from the stump.

The tree, however, has been so largely planted in many parts of the States and in Canada, and succeeds so well, even so far west as British Columbia, that it may again become generally useful as a timber tree.

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[1] *Proc. U.S. Nat. Museum*, 1882, p. 49.

[2] *Trees of Massachusetts*, i. 213.

CULTIVATION

The black walnut was first described by Parkinson,[1] and was introduced into England by the younger Tradescant before 1656, as it is mentioned in the list[2] of the plants growing in his garden at that time. A tree was growing in Bishop Compton's garden at Fulham in 1688, according to Ray.[3]

The black walnut is easy to grow from seed, but, except the hickories, none is more difficult to transplant, on account of the long fleshy tap-roots which it forms at an early age, and which, when grown in the good deep soil which it likes, are at a year old often three or four times as long as the seedling itself. For this reason, unless special care is given to its treatment, it is not likely to become so fine a tree as when sown *in situ*, and, though I have successfully transplanted many at one or two years old, I would much prefer the other method.

Though the nuts ripen in England in hot summers, they are not so large, and do not, I think, produce such strong plants as those imported from North America, and, if possible, I should prefer to get them from trees growing in Canada or New England than from farther south.[4] The nuts are best sown when ripe, as if kept dry for some time, they either lose their germinating power or come up so late that they make weak plants. In any locality which is subject to late frosts it would be better to sow them in boxes at least two feet deep and plant them out when a year old, as like many exotic trees they do not ripen their young wood well, and are liable to be frozen back in winter or spring, which induces a bushy instead of a straight habit of growth.

As this tree requires to be well sheltered and drawn up by surrounding trees in order to form a tall and valuable trunk, it should be sown or planted in small deeply-dug patches in a rich wood, kept free from weeds and protected from mice, rabbits, and boys, until the trees are six to eight feet in height, which they should be under favourable circumstances at four to six years after sowing.

All these difficulties have made the tree unpopular with nurserymen, who rarely care to grow trees for which there is little regular demand. But the great value of the timber, its rapid growth on suitable places, and its perfect hardiness when once established, give it, in my opinion, so much importance, that, however troublesome it may be in its early stages, it should be tried at least on a small scale as a timber tree in the warmest and best soils of the southern, eastern, and west midland counties. For further particulars of the nursery treatment of this tree see Cobbett's *Woodlands*, Art. 553; or *Arboriculture*,[5] iv. 7, July 1905. Cobbett, who knew the tree well, considered as I do that it was a hardier and better timber tree than the common walnut.

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[1] *Theatrum Botanicum*, 1414 (1640).

[2] *Museum Tradescantianum*, 147 (1656).

[3] *Historia Plantarum*, ii. 1798 (1688)—no doubt the tree mentioned by Loudon as existing in 1835 (see p. 268).

[4] But the question as to whether the seeds of trees grown in a comparatively cold climate produce hardier plants than seed from a warm one, is as yet unsolved; and Prof. H. Mayr of Munich, than whom there is no better authority, is inclined to believe that the differences which are observed in the comparative resistance to frost depend on the variable constitution of the individual plant rather than on inherited power.—Cf. H. Mayr, *Fremdl. Wald. u. Park-bäume* (Berlin, 1906).

[5] A magazine of the International Society of Arboriculture; J. P. Brown, Connersville, Ind., U.S.A.

The black walnut cannot be expected to attain great size except on deep soil in a warm situation. A tree grown from a nut, brought by my father from America over 60 years ago, is now only about 60 feet high and 3 feet in girth, on the dry oolite of the Cotswolds; whilst in Kent, on good loam, it has attained 100 feet by 12 feet in about 100 years, and probably contains as much timber, and that of twice the value, as any oak of its age in Great Britain. It seems indifferent to the chemical nature of the soil, if it is deep, light, and well drained, and should have a southern or western aspect.

It is stated in *Woods and Forests* that the tree is almost if not entirely rabbit-proof, for when nearly everything else is barked it is left untouched, even in a young state.

I have no certain knowledge as to the age which this tree attains, but from the fact that the old ones at Fulham Palace and Syon are dead or dying, I should suppose that, like the common walnut, it is not a very long-lived tree.

CULTIVATION IN GERMANY AND FRANCE

The high value of the timber of the black walnut has led to experiments with the tree in Continental forests. These trials have, however, hitherto been only on a small scale.

In the State forests of Prussia the black walnut has been planted in twenty-two different stations, the whole area under cultivation being thirty-one acres, the separate plots varying in size from seven acres to a rood. Schwappach[1] draws the following conclusions from the results obtained in these experimental plots:—Of all the exotic species which have been tried in Prussia, *Juglans nigra* is the most exacting as regards soil and climate. It only thrives on deep moist rich soils, such as loamy sand rich in humus or pure loam, and never succeeds on shallow soils of any kind, or on wet clay or sand. It requires for its good development a considerable amount of warmth and a long season of vegetation. It has only succeeded on the best oak soils, such as the alluvial lands by the rivers Oder, Mulde, and Elster, and in certain restricted areas of the hilly land of central and western Germany.

Schwappach gives a description of the long tap-root of the seedling, and the consequent difficulty in transplanting; but he lays stress upon the fact that in Germany the seedlings normally make their appearance very late, and believes that this is one of the main causes of failure, as the young plants do not then ripen their wood, and are destroyed by late frosts. He advocates the early germination of the seeds by artificial means, such as by placing them in pits covered with straw, soil, and horse-dung. These speedily germinate, and are then planted in the forest in gaps of about a rood in extent, which are the result of clear felling, or under the existing canopy of an old wood where the trees will soon be removed. The black walnut requires strong sunlight for its successful growth, yet lateral protection is necessary during the first few years. Heavy shade is hurtful, as it hinders the ripening of the wood of the shoots. The black walnut, after it has successfully passed the dangerous period of youth, becomes perfectly hardy; and older plants resist both spring and winter frosts. Schwappach advocates close planting, with beech or hornbeam as nurses, and recommends thinning at 15 to 20 years old, to remove badly-shaped trees, and to give more light to those which are destined to remain.[1]

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[1] *Ergebnisse Anbauversuche Fremländischen Holzarten*, 37 (1901).

In France Henry has seen a small plantation of black walnut near Annecy; but the results obtained were unsatisfactory, as the young plants had suffered much from frost. M. Pardé,[2] however, strongly recommends its cultivation, and points out that, unlike the common walnut, it can be grown as a forest tree; and states that at Les Barres it sows itself regularly and abundantly.

REMARKABLE TREES

The largest tree which we know of in England is growing in the London County Council public park of Marble Hill, Twickenham, in rich alluvial soil close to the Thames. It was measured by Sir Hugh Beevor and Dr. Henry in August 1905, and the height was found to be 98 feet, the stem girthing at 5 feet up 14 feet 3 inches. The bole is about 18 feet long, dividing into two great limbs, with large spreading branches, forming a beautifully symmetrical crown. The diameter of the greatest spread of the branches was 93 feet (Plate 76).

Perhaps the next finest tree now standing in England is the one which I figure (Plate 77), and which grows on a bank at The Mote, near Maidstone, the property of Sir Marcus Samuel, Bart. I have twice measured this tree, first in 1902, when I made it 103 feet by 12 feet in girth, and again in 1905, when I made it 101 feet by 12 feet 6 inches. I am informed by Mr. Bunyard of Maidstone that it was probably planted about 100 years ago by his grandfather. The tree is so healthy, and apparently growing so fast, that it may become very much larger than it now is. At Gatton Park, Surrey, the seat of J. Colman, Esq., there was, in 1904, a tree about 100 feet by 9 feet 6 inches in girth, with a very tall, handsome trunk. Another at the same place, which, when I saw it, was lying on the ground, was about 95 feet by 9 feet, with a bole 10 feet long, and, according to the measurement given me by the late Mr. Cragg, agent for the estate, contained 315 cubic feet of timber.

At Highclere, Berks, there is a fine tree 90 feet by 9 feet 6 inches; and at Bute House, Petersham, Henry measured one 78 feet by 11 feet 10 inches in 1903. At Burwood House, Surrey, Col. Thynne has measured a tree, which I have not seen,

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[1] Mr. John Booth of Berlin, who has for many years been one of the best advocates for the planting of exotic trees for timber, tells me that the black walnut has been largely planted near Strassburg under the direction of Forstmeister Rebmann, and the results are extremely successful.

[2] *Les Principaux Végétaux Ligneux Exotiques*, p. 21.

79 feet by 12 feet. At Syon House there was a fine tree mentioned by Loudon, as then 79 feet high and 2 feet 11 inches in diameter. In 1849, according to the manuscript catalogue of trees at Syon, it was 90 feet by 7 feet 3 inches; when I saw it in 1903 its top was gone, the tree fast decaying, and the girth about 10 feet.

At Youngsbury, near Ware, Herts, there are two fine trees which Mr. H. Clinton Baker measured in March 1906. The larger was 90 feet high by 11 feet 10 inches in girth; the smaller 80 feet by 11 feet 3 inches. At Albury, Surrey, near the gardener's cottage, there is a tree which measured in 1904, 90 feet by 9 feet 2 inches. At Arley Castle a black walnut is bearing mistletoe. At Barton, near Bury St. Edmunds, there is one which is about 75 feet by 7 feet, which cannot be more than about 60 years old.

Sir Hugh Beevor reports a fine tree, 80 feet high by 12 feet girth, at Spixworth Hall, Norfolk. In the rooms of the Hall there is some flooring made of locally-grown black walnut. At Wimpole, he measured another tree 78 feet by 12 feet 8 inches.

At Strathfieldsaye there is a plantation of eighteen young black walnuts in a group on the lawn, which, though about eighteen years old when I saw them in 1903, were only 8 to 10 feet high. Three others raised at the same time but planted out younger are twice as high. This seems to me to prove the importance of not keeping this tree long in the nursery. A fine tree on the other side of the house at the same place is about 80 feet by 7 feet, and had a few nuts on it even in the wet season of 1903.

At Fulham Palace there was a tree, which, according to Loudon, was 150 years old in 1835, being then about 70 feet high and 5 feet in diameter. In 1879[1] this tree was 16 feet in girth breast-high, and had passed its prime; and has been quite dead for ten years. This is the largest girth of any black walnut recorded in England.

At Bisham Abbey, near Marlow, the property of Sir H. J. Vansittart Neale, growing in a grove near the garden, where they have been drawn up by other trees, are four fine black walnuts, of the age of which there is no record. The tallest is nearly if not quite 100 feet high, with a clean bole about half as long, and a girth of 8 feet 2 inches; the others have shorter trunks, the biggest being 10 feet 3 inches in girth, and another 8 feet 6 inches, but are nearly as tall.

At Corsham Court, Wilts, the seat of Lord Methuen, is one of the finest specimens in England, with a clean trunk about 35 feet without a branch and 11 feet 5 inches in girth. It is 75 to 80 feet high, and has a very spreading crown of drooping branches, which cover a space 30 yards across. At Lacock Abbey, near Corsham, the seat of Mr. C. H. Talbot, are some good trees planted by the grandfather of the present owner between 1780 and 1800, of which the largest is about 100 feet by 11 feet 5 inches, with a bole of 8 feet, but this has ceased to bear nuts. The others were planted subsequent to 1828, and the best of them is 60 to 70 feet high by 7 feet girth, and bears nuts profusely.

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[1] Figured in *Gard. Chron.* 1879, xi. 372, t. 52. *Cf.* p. 265.

At Walsingham Abbey, Norfolk, the seat of H. Lee Warner, Esq., there was a specimen figured in Grigor's *Eastern Arboretum*, p. 300, as a tree clothed to the ground with foliage, and of which the spreading branches were propped up. In 1840 it was 8 feet in girth, with a spread of branches 165 feet in circumference, but is now much decayed.

At Brightwell Park, Oxon, the property of R. Lowndes Norton, Esq., there are three or four well-grown trees about 50 years old, the largest of which measures 68 feet by 5 feet 10 inches, and bears fruit abundantly. The leaves of these trees were conspicuous by their yellow colour in the first week of October.

At all the four last-named places these trees have been known as hickories, and it is probable that others of the so-called hickories in England are really black walnuts.

Two trees[1] growing close together at The Firs, Manor Lane, London, S.E., both measured, in 1886, 10 feet 9 inches at 4 feet above the ground, and were estimated to be 90 feet high. They were then in excellent health, and bore good crops of nuts, which, however, were rarely perfectly developed.

Many other trees no doubt exist in old places south of the Thames; but we have never seen or heard of any large ones in the midland or western counties. Sir Charles Strickland, however, tells us that the black walnut is quite hardy in Yorkshire; and that he has trees at Hildenley, 15 to 20 feet high and ripening seed, whilst at Housham, another place of his in the same county, they thrive even better in the woods, where they look like becoming fine timber trees.

In Ireland, the largest tree seen by Henry is at Ballykilcavan, Queen's County: it measured in 1907, 68 feet high by 9½ feet in girth. We know of no trees of any size in Scotland.

The largest which we have heard of in Europe is a tree growing at Schloss Dyck, the seat of Fürst Salm-Dyck in Germany, which was planted in 1809, and in 1904 measured 35 metres high by 3.58 metres in girth, with a crown diameter of 35 metres.

TIMBER

It is very strange that though this timber has been imported on a large scale from North America for many years, both to England and the Continent, where it commands a very high price, its value is quite unknown to the English country timber merchant, and none of the writers on wood seem to know much about it. Even Marshall Ward, in his edition of Laslett (1894), says (p. 181) that it will not bear comparison with the quality of either Black Sea or Italian walnut wood. Boulger, in *Wood* (p. 339), says that it is "more uniform in colour, darker, less liable to insect attack, and thus more durable than European walnut." Stone says (p. 211), "This wood is readily confused with *J. regia*."

I can only say that I have seen four different trees felled in England, of which the wood was perfectly distinct by its purplish colour from that of any European walnut; and though I have not been able to get any definite proof of the truth of

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[1] *Gard. Chron.* 1886, xxvi. 616, fig. 120.

Boulger's statement as to its freedom from insect attack, yet the furniture which I have had made from three of the trees in question is distinctly superior to that of common walnut, and as good as imported black walnut, in colour; and when properly seasoned, for which three or four years should be allowed, as good cabinetmaker's wood as the best Circassian or Italian walnut: and Unwin,[1] quoting Nordlinger and Mayr, says that the timber of trees grown in Germany has the same specific gravity and the same beautifully coloured heartwood as in America. I am informed by experienced cabinetmakers and timber merchants that the colour and quality of the wood now imported is, either on account of its being younger or grown in different localities, inferior to what it used to be when first introduced to this market, and Mr. A. Howard told me that he could not buy American timber of better quality than that of a tree blown down at Albury which was given me by the Duke of Northumberland. It takes a beautiful polish either with oil or French polish, has not warped in the least degree, and has in many cases a beautifully variegated figure. The sapwood is thick and of a paler colour, and should not be used in first-class work any more than that of the common walnut, which is always attacked sooner or later by the larvæ of a woodboring beetle.

From what I saw of it in America, I believe it to be extremely durable when exposed to the weather, as it lasts long in fences, and large canoes were made from it, whilst it was the favourite wood for furniture until its increasing scarcity and price caused it to be superseded by oak and mahogany.

Old trees often show a beautiful wavy grain, as well as a variety of markings, and from the forks and burrs veneers are cut, which, though of a different colour, are equal in beauty and pattern to mahogany or satinwood.

Cobbett[2] states, though he does not appear to have seen it himself, that there was at New York part of a black walnut trunk, which measured 36 feet round at the base, and had been scooped out and used as a bar-room, and afterwards as a grocer's shop, and that this tree, if it had been sawed into inch boards, would have yielded 50,000 feet, worth at that time $1500, but this seems exaggerated; though Loudon states (p. 1438) that a tree, perhaps the same as the one Cobbett speaks of, and grown on the south side of Lake Erie, was exhibited in London in 1827, which was 12 feet in diameter, hollowed out and furnished as a sitting-room.

(H. J. E.)

[1] *Future Forest Trees*, 38 (1905).

[2] *Woodlands*, Art. 553.

JUGLANS CINEREA, BUTTERNUT

Juglans cinerea, Linnæus, *Sp. Pl.* 1415 (1763); Loudon, *Arb. et Frut. Brit.* iii. 1439 (1838); Bentley and Trimen, *Medicinal Plants*, iv. t. 247 (1880); Sargent, *Silva N. America*, vii. 118, tt. 331, 332 (1895); and *Manual Trees N. America*, 126 (1905).

A tree attaining in America occasionally 100 feet in height, with a girth of 9 feet, but usually smaller in size, dividing at 20 or 30 feet above the ground into many stout horizontal limbs, and forming a broad, low, round-topped head. Bark of young trees smooth and light grey, becoming in older trees deeply fissured, with broad scaly ridges.

Leaves with eleven to seventeen leaflets, which are sub-opposite, sessile, oblong, unequal-sided, rounded, and slightly unequal at the base, acuminate at the apex; margin finely serrate, the tips of the serrations being directed outwards, ciliate; upper surface finely pubescent with stellate and long simple hairs; lower surface pale, with numerous fine stellate hairs, there being some glandular hairs on the midrib towards its base. Rachis with numerous short glandular hairs. Young shoots with white sessile glands and numerous short white glandular hairs; old shoots pubescent. The leaf-scars are semicircular or triangular, with the upper edge a straight line, and furnished with a transverse band of pubescence.

Flowers: staminate catkins 2 to 3 inches long; scales with six puberulous lobes; bract rusty-pubescent with acute apex; stamens eight to twelve. Pistillate flowers in six- to eight-flowered spikes; involucre with viscid glandular hairs, and slightly shorter than the linear-lanceolate perianth lobes.

Fruit: in drooping clusters of three to five, ovate oblong with two or rarely four obscure ridges, coated with rusty clammy hairs, 1½ to 2½ inches in diameter. Nut ovate, abruptly acuminate and contracted at the apex, with eight ribs, internally two-celled at the base and one-celled above the middle with a narrow pointed apical cavity.

VARIETIES AND HYBRIDS

No varieties are known. A hybrid between it and *Juglans nigra* has been observed. See *Juglans nigra*.

IDENTIFICATION

The best mark of distinction of this species at all seasons is the leaf-scar, which has a transverse raised band of pubescence above its upper margin, which is never notched, and is straight or slightly convex. In winter the following characters are observable in the twigs and buds. Twigs stout, reddish brown, covered with dense glandular pubescence. Leaf-scars, as described above, obovate, on prominent pulvini, with three groups of bundle-dots. Terminal buds oblong, greyish, densely pubescent, the two outer scales conspicuously lobed at the apex, the two inner scales scarcely lobed. Lateral buds, directed outwards at an angle of 45°, small, ovoid, pubescent; frequently two superposed. Pith dark brown, with narrow chambers. (A. H.)

DISTRIBUTION

According to Sargent, it occurs in rich moist soil near the banks of streams and on low rocky hills from southern New Brunswick and the valley of the Saint Lawrence in Ontario to eastern Dakota, south-eastern Nebraska, central Kansas, and northern Arkansas, and on the Appalachian Mountains to northern Georgia and northern Alabama; most abundant and of its largest size northward. The grey walnut or butternut, as it is commonly called, is a common tree over the same region as that which produces the black walnut, but never attains the same size, and, as a rule, unless drawn up in the forest is a much more spreading and less valuable tree. It does not in New England usually exceed 30 to 50 feet in height, with a trunk 1 to 4 feet in diameter, but sometimes in the rich forests of the Wabash valley attains greater dimensions. Ridgway says, *loc. cit.* 76, that two trees felled in the "Timber Settlement," Wabash county, measured 97 feet and 117 feet in length, with clear trunks 50 feet and 32 feet long, and 1 foot 10 inches in diameter. Pinchot and Ashe, *loc. cit.* 82, say that in North Carolina it is nowhere common, but in cool rich mountain valleys it attains 70 feet high with a diameter of 3 feet. In New England Emerson, *loc. cit.* 210, mentions a tree in Richmond, Mass., which was 13 feet 3 inches in girth at the smallest place below the branches. I never saw any such trees as these; and near Ottawa, where the tree is approaching its northern limit of distribution, it was a small branchy tree bearing little fruit.

INTRODUCTION

The butternut was first described by Parkinson,[1] and was apparently introduced into England at the same time as the black walnut, *i.e.* sometime before 1656, as it is probably one of the species mentioned by Tradescant[2] as growing in his garden. Loudon states that it was introduced into cultivation by the Duchess of Bedford in 1699; but the tree referred to by him was *Carya alba.*[3]

CULTIVATION

Though it must have been planted in many places in this country the butternut seems to be now a very scarce tree. The only one I have seen of any size grows in the grounds of Mr. C. S. Dickens at Coolhurst, near Horsham, and was in 1902 52 feet high and 4 feet 2 inches in girth. This produced fruit in 1900 from which I raised two seedlings, one of which is now growing at Colesborne. I noticed that the roots of these seedlings instead of being long, fusiform, and free from rootlets, as in *J. regia* and *J. nigra*, formed a thick, fibrous mass, which made the tree

[1] *Theatrum Botanicum*, 1414 (1640).

[2] *Museum Tradescantianum*, 146, 147 (1656).

[3] Aiton, *Hort. Kew*, iii. 360 (1789), *ex Brit. Museum Sloane MSS.* 525 and 3349.

very easy to transplant. I have since then raised numerous seedlings from imported seed, by sowing them both in pots and in the open ground. If allowed to become dry they sometimes lie over a year, and should therefore be sown as soon as ripe. The young trees are distinguishable from those of *J. nigra* by having fewer pairs of leaflets, but they grow quite as fast, and are quite as hardy as the latter. Both *nigra* and *cinerea*, though liable to injury from late spring frosts, are much hardier as regards winter frost when old enough to ripen their wood, but as, like other walnuts, they do not bear pruning well, they require careful attention when young in order to become shapely trees. Sir Charles Strickland has raised from seed plants at Boynton in Yorkshire which grew to five or six feet high, but all ultimately died.

Mr. J. H. Bonny, Ratcliffe Cottage, Forton, Garstang, sent specimens to Kew in 1900 from a tree 60 years old, which fruited for the first time in that year. It had only attained 22 feet high by 2½ feet in girth at 5 feet from the ground. There is a tree at Bayfordbury which produced a few nuts in 1905. It is 35 feet high by 3 feet 2 inches in girth, and is as large as a black walnut planted beside it. At Tredethy in Cornwall, the seat of F. T. Hext, Esq., I am told by Mr. Bartlett, that there was in 1905 a tree 35 feet by 2 feet 2 inches.

At Riccarton near Edinburgh, the seat of Sir James Gibson Craig, Bart., there is a butternut growing in a sheltered spot which Henry measured in 1905, and though its position makes it difficult to measure accurately, he believes it to be about 50 feet by 3 feet 3 inches.

In Ireland Henry measured in 1904 at Kilmacurragh, Co. Wicklow, a tree 32 feet high by 3 feet 4 inches; while at Charleville in the same county, the seat of Lord Monck, a tree, planted probably in 1869, was 25 feet high by 2 feet in girth.

TIMBER

The timber of this tree, though it resembles that of other walnuts in texture and grain, is much inferior in colour to that of the black walnut, but Hough[1] says that though not so high-priced it is nevertheless of great value for interior finish and wainscoting. In Prof. Sargent's house at Brookline, near Boston, I saw a very handsome mantelpiece and some panelling made from it, and it is occasionally used for furniture. It is pale brown in colour, with whitish-grey sapwood, and the burrs are sometimes cut into handsome veneers. Mr. John Booth[2] states that he cut down some exotic trees planted by his father at the celebrated Flottbeck nurseries near Hamburg when about 50 years old; and from the wood of a butternut wainscoted a room; "the polish was even finer than that of *J. nigra*, with a splendid glossy hue."

Emerson says, *loc. cit.* 209, that from the bark a mild purgative is made, and that the Shakers at Lebanon obtain a rich purple dye from it. The common dye used by the early settlers for their homespun cloth was from the husk of the butternut, which gives a fawn colour. The young half-grown nuts make excellent pickles if gathered early in June, but the ripe nuts, though eaten by boys and Indians, are oily and soon become acrid.

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[1] *American Woods*, p. 61.

[2] *Gard. Chron.* xxx. 407 (1901).

According to L. B. Case, who wrote an interesting article[1] on this tree, if an incision is made in the trunk early in spring before the unfolding of the leaves, it yields a rich saccharine sap, nearly if not quite equal to that obtained from the sugar maple. The medicinal uses of the bark are fully explained in Bentley and Trimen's work cited above. (H. J. E.)

JUGLANS RUPESTRIS, Texan Walnut

Juglans rupestris,[2] Engelmann, *Sitgreave's Report*, 171, t. 15 (1853); Sargent, *Silva N. America*, vii. 125, tt. 335, 336 (1895), and *Manual Trees N. America*, 129 (1905).

The typical form, with small leaflets, which has been introduced into cultivation in Europe, is a shrub or small tree; bark of young trunks smooth, pale, whitish, becoming in older trees deeply furrowed and scaly. Leaflets, seven to fifteen or more, small, one to three inches long, sub-sessile, ovate or lanceolate, never oblong, apex acuminate, base rounded and unequal-sided, crenulate-serrate and non-ciliate in margin; upper surface with scattered minute pubescence; lower surface green with scattered minute brown hairs and axil tufts. Rachis with numerous sessile yellow glands and glandular hairs. Young shoots with numerous sessile yellow glands, interspersed with glandular hairs and obcordate leaf-scars, which are notched above. Older shoots shortly pubescent.

Flowers: staminate, catkins slender, two to four inches long, scales three- to five-lobed, with ovate-lanceolate tomentose bracts; stamens twenty. Pistillate flowers few in a spike, tomentose, involucre irregularly divided into a laciniate border, slightly shorter than the ovate acute calyx-lobes.

Fruit: globose or rarely oblong, very variable in size, ½ to 1½ inch in diameter; husk glabrate or coated with rufous hairs; nut globose without ridges, often compressed at the ends, dark brown or black, grooved with longitudinal simple or forked grooves, four-celled at the base, two-celled at the apex.

Var. *major*, Torrey, *Sitgreave's Report*, 171, t. 16 (1853): usually a tree, attaining 50 feet in height with a trunk 15 feet in girth. In this form the leaflets are large, reaching 6 inches in length; the fruit is also larger. It would appear that this variety is the western form, the typical form being characteristic of the eastern part of the area of distribution of the species.

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[1] *Woods and Forests*, 1884, p. 200.

[2] It is probable, as Rehder points out in *Cycl. Am. Hort.* ii. 846, that *Juglans longirostris*, Carrière, in *Rev. Horticole*, 1878, p. 53, fig. 10, belongs to this species.

IDENTIFICATION

The form of this species usually cultivated in England is distinguished in summer by its small leaves, bushy habit, and the other characters given above. In winter the following characters are available: — Twigs very slender, olive-green or brown, densely pubescent. Leaf-scars set obliquely on prominent pulvini, small, obcordate, notched above, without pubescent band above the upper margin; bundle-dots in three groups. Terminal bud elongated, slender, densely and minutely pubescent, the tips of the two outer scales slightly lobed. Lateral buds, arising at an angle of 45°, minute, ovoid, pubescent, usually solitary. Pith small, brownish, with wide chambers.

DISTRIBUTION

According to Sargent this species occurs on the limestone banks of the streams of central and western Texas, shrubby or rarely more than 30 feet high (var. *typica*); common and of larger size in the cañons of the mountains of New Mexico and Arizona south of the Colorado plateau. It is also met with in northern Mexico,[1] where it frequently leaves the mountain cañons, following the water-courses which are dry throughout most of the year. In such situations its average diameter is 12 to 18 inches, and its height 20 to 30 feet; the nuts, less than an inch in diameter, are scarcely edible.

CULTIVATION

This species was discovered in western Texas in 1835 by Berlandier. It was growing in 1868 in the Botanic Garden at Berlin, according to a note in Engelmann's Herbarium.[2] It does not seem to have been known in England till 1894, when seeds from Fort Huancha in Arizona were sent to Kew by Sargent. A tree grown from this seed has attained now (1905) about 12 feet in height. There is one nearly as large at Tortworth, and a seedling from Kew is planted at Colesborne, where it seems at least as hardy as the common species and ripens its wood earlier. A tree planted at Mount Edgcumbe, near Plymouth, in 1898 is 9 feet 4 inches high, with a spread of 10 feet. It has been cut back twice, and looks better as a bush than as a tree. (A. H.)

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[1] *Garden and Forest*, 1888, p. 106.

[2] Sargent, *Silva N. America*, *loc. cit.* 126.

JUGLANS MANDSHURICA, MANCHURIAN WALNUT

Juglans mandshurica, Maximowicz, *Prim. Fl. Amur.* 76 (1859); and *Mél. Biol.* viii. 630, fig. (1872); C. De Candolle, in *D.C. Prod.* xvi. 2, 138 (1864); *Gard. Chron.* 1888, iv. 384, fig. 53.
Juglans regia octagona, in *Revue Horticole*, 1861, p. 429, fig. 106.
Juglans regia cordata, in *Garden*, 1896, p. 478, fig.

A tree attaining 60 feet in height and 5 feet in girth. Bark dark ashy in colour, furrowed in old trees. Judging from herbarium specimens, as I have not been able to examine living trees in England, this species differs little in character of leaves and branchlets from *Juglans Sieboldiana*. Maximowicz, who observed both species growing wild, states that he was unable to find any good distinctions between the two species except in the characters of the nut.

The fruit occurs in short racemes, six to thirteen in a cluster, and is globular-ovate to oblong, viscid, and stellate pubescent. The nut resembles that of *Juglans cinerea*, but is less sharply ridged, globose or ovate, rounded at the base, abruptly and shortly acuminate at the apex, eight-ribbed, with the intervals much wrinkled.

This species occurs in mountain woods in eastern Manchuria, between the Bureia range and the Sea of Japan, from lat. 50° to the Korean frontier. It is frequent along the river Amur in its lower part and on its tributaries. This species is also widely spread throughout Northern and Western China, where it is common in mountain woods at low altitudes, from Chihli through Hupeh and Szechwan to Yunnan. So far as I have seen it, both in Hupeh and Yunnan, it never makes a large tree, and rarely exceeds 40 feet in height, but Komarov informed us that in Mandshuria it attains 80 feet high by 19 to 20 in girth.

This plant was introduced[1] into the Botanic Garden of St. Petersburg by Maximowicz from seeds sent from the Amur. A tree[2] from seed planted in 1879 in the Arnold Arboretum bore fruit in 1883, which was large, more nearly spherical and less rough than the butternut, and of good flavour. The tree is described as being compact and handsome in habit, and likely to become of value as a fruit tree in the northern parts of the United States, where the common walnut cannot be grown successfully.

Specimens were sent to Dr. Masters[3] in 1888 from a tree which had fruited in the nursery of Mr. J. van Volxem at Brussels, where the fruit ripens some weeks before that of the common walnut, and the tree seems less injured by spring frosts.

(A. H.)

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[1] Bretschneider, *Hist. Europ. Bot. Discoveries in China*, i. 609 (1898).

[2] *Garden and Forest*, 1888, pp. 396, 443.

[3] *Gard. Chron.*, *loc. cit.*

JUGLANS CORDIFORMIS, Cordate Walnut

Juglans cordiformis, Maximowicz, *Mél. Biol.* viii. 635, *cum fig.* (1872); Shirasawa, *Icon. Ess. Forest Jap.*, text 35, t. 17 (1899); Rehder, *Mittheil. Deut. Dendrol. Gesell.* 1903, p. 117; *Gardeners' Chronicle*, 1901, xxx. 292, Supplementary Illustration.

Juglans Sieboldiana, var. *cordiformis*, Makino, in *Tokyo Bot. Mag.* 1895, p. 313.

A tree attaining 50 feet in height and 6 feet in girth. Bark, according to Shirasawa, remaining smooth for a long time, becoming fissured with age.

Leaves with eleven to thirteen leaflets, which are sub-opposite, oblong with unequal sides, acute or acuminate at the apex, cordate at the base, sessile or subsessile, the petiolule not exceeding $\frac{1}{16}$ inch, the base of the leaflet extending over the rachis so that the leaflet appears to be more sessile than is the case in *J. Sieboldiana*; serrations fine, shallow, irregular, directed forwards and ciliate; upper surface finely pubescent, with only tufted hairs; lower surface pale in colour, pubescent, with numerous stellate hairs, dense along the midrib on which the hairs are glandular; rachis with densely glandular long reddish hairs, sessile glands being absent. Young shoots covered with long white hairs, which are tipped with red glands and are much denser than in *J. Sieboldiana*; no sessile glands visible. Leaf-scar as in that species.

Flowers: male catkins twelve inches long or more; female catkins about five inches long, bearing seven to twelve flowers.

Fruit globose; nut heart-shaped, much flattened, sharply two-edged, with a shallow longitudinal groove in the middle of each flattened side, smooth over the surface, rather thin-shelled.

Identification

Readily distinguished in summer by the cordate leaflets and the young shoots densely covered with long white hairs, which bear red glands at the tips. See under *Juglans Sieboldiana.*

In winter the following characters are available:—Twigs stout, brown, covered with long glandular hairs, which tend, however, to fall off from the lower part of the shoot. Leaf-scar large, set slightly obliquely on pulvini which are scarcely elevated, obovate with two lateral lobes and notched above; the upper margin with a transverse raised band of pubescence; bundle-dots in three groups. Terminal bud conical, but compressed laterally, brown, densely pubescent, the two outer scales lobed at the apex. Lateral buds often two superposed, small, brown, ovoid, arising from the twigs at an angle of 60°, densely pubescent. Pith large, brown, with wide chambers.

Distribution

According to Maximowicz, this species occurs in Nippon. Shirasawa says that it is spread along the banks of rivers in the temperate regions of Japan, being rare in the mountains. The wood, according to this author, is light, with little difference between the sapwood and heartwood, and when well seasoned does not warp or split, and on this account it is much esteemed for making gun-stocks. Sargent[1] did not find this tree in Japan, and says that its peculiar nuts are considered by Japanese botanists to be merely extreme varieties of *Juglans Sieboldiana.* However, the species is kept up as distinct by Matsumura,[2] and cultivated specimens at Kew of the two species can be readily distinguished.

Rehder states in 1903 that a tree in the Arnold Arboretum raised from seed of true *Juglans cordiformis* fruited some years ago. The fruits, however, did not show the characteristic form of this species, and he doubted whether the tree in question was true *cordiformis*, or only a variety of *Sieboldiana* with aberrant fruit.

Nuts were obtained in 1862 by Albrecht,[3] physician to the Russian Consulate at Hakodate, which were sown in the Botanic Garden at St. Petersburg, and produced healthy plants, which were about four feet high, in 1872. Maximowicz also found the nuts in the market at Yokohama. Sargent, who found them offered for sale by the Nurserymen's Association of Yokohama, was informed that they were collected on the slopes of Fujisan.

The tree has been recently sent out by Continental nurserymen, and is hardy in this country. A specimen at Kew, which was raised in 1899 from seed procured from Harvard, is now about twenty feet high. The male catkins, which are produced freely and expand in May, give the tree a striking appearance, but the fruit has not yet matured. (A. H.)

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[1] *Forest Flora of Japan*, 60 (1894).

[2] *Shokubutsu Mei-I*, 155 (1895).

[3] See Maximowicz, *loc. cit.*, and Bretschneider, *European Bot. Discoveries in China*, i. 622 (1898).

JUGLANS STENOCARPA, Narrow-Fruited Walnut

Juglans stenocarpa, Maximowicz, *Prim. Fl. Amurensis*, 78 (1859); and *Mél. Biol.* viii. 632, *cum fig.* (1872); Rehder, *Mittheil. Deut. Dendrol. Gesell.* 1903, p. 117.

A tree of which only the fruits are known in the wild state. The following description of the foliage is taken from a specimen cultivated at Kew.

Leaves with eleven to thirteen leaflets, of which the terminal one in well-developed specimens is much broader than the others, being obovate with a short acuminate apex (4 inches broad by 6 inches long). The lateral leaflets (2¼ inches broad by 6 inches long) are oblong, acuminate at the apex, rounded and unequal at the base, subsessile, the petiolule being less than $\frac{1}{16}$ inch; upper surface with scattered stellate pubescence; lower surface pale in colour, with similar pubescence; all the leaflets coarsely and almost crenately (not sharply) serrate and ciliate in margin. Rachis with very scattered stellate hairs and white sessile glands, there being no glandular hairs. Young shoots glabrous with numerous yellow glands, there being, however, a slight pubescence towards the base of the shoot. Older shoots glabrous, grey, shining, smooth. Leaf-scar broadly obcordate, notched at the summit, three-lobed, and without any band of pubescence on the upper margin.

The nuts, on which Maximowicz founded the species, are described by him as being shining, cylindrical or oblong-oval, slightly narrowed at the base, acuminate at the apex, eight-ribbed, with the intervals between the ribs deeply and obtusely wrinkled. The nuts are cinnamon brown in colour and are two-celled.

This species, having serrate pubescent leaflets and non-bearded leaf-scars, can only be confused with *Juglans nigra* and *J. rupestris.* It is readily distinguished in summer from these and all other species of walnut in cultivation by the broad terminal leaflet, which is always well marked in fully developed leaves.

In winter the following characters are available:—Twigs stout, yellowish brown, shining, minutely pubescent towards the apex, glabrous elsewhere. Leaf-scars large, on pulvini which are only slightly elevated, broadly obcordate, notched above and without any pubescent band along their upper margin; bundle dots in three groups. Terminal bud conical, brown, tomentose, the two outer scales slightly lobed at the apex. Lateral buds small, ovoid, tomentose, arising at an angle of 45°. Pith large, buff in colour, with narrow chambers.

The nuts of the tree were found in Russian Manchuria by Maximowicz. Nothing is known about the tree itself.

Specimens are cultivated in the Arnold Arboretum which were obtained from Regel and Keiselring's nursery at St. Petersburg. There are two small plants at Kew which were obtained under the name *Juglans mandshurica* from a Continental nursery. (A. H.)

JUGLANS SIEBOLDIANA, Siebold's Walnut

Juglans Sieboldiana, Maximowicz, *Mél. Biol.* viii. 633 fig. (1872); Lavallée, *Arbor. Segrezianum*, p. 1, tab. I. et II. (1885); *Garden*, 1895, xlvii. 442.

Juglans ailantifolia, Hort. Sieb. *ex* Lavallée, *loc. cit.*; and Carrière in *Revue Horticole*, 1878, p. 414, figs. 85 and 86.

A tree attaining 50 feet in height and 5 feet in girth.

Leaves with thirteen to fifteen leaflets, which are sub-opposite, oblong, acuminate at the apex, with base rounded and unequal, sub-sessile, the petiolule being less than $\frac{1}{16}$ inch; serrations fine, shallow, and irregular, directed forwards, ciliate between the teeth; upper surface finely pubescent, with both single and tufted hairs; lower surface pale in colour, covered with numerous stellate hairs, denser close to the midrib on which there are glandular hairs; rachis with long brown glandular hairs and a few small glands near its base. Young shoots green, with long white glandular hairs and white sessile glands; lenticels at first white, becoming brown, conspicuous. Leaf-scars obcordate, three-lobed, deeply notched above, and with a transverse band of pubescence along the upper edge.

Flowers: staminate catkins very long, up to 12 inches, with bracts obtuse at the apex and very villous, scale five-lobed. Pistillate spikes, five to twenty flowered, the rachis and flowers covered with rufous tomentum.

Fruit in long racemes which are ten to twenty inches long; globose to ovate-oblong, shortly acuminate at the apex, viscid and covered with stellate hairs. Nuts ovoid or globose, rounded at the base and acuminate at the apex, with thick wing-like sutures, very slightly wrinkled and pitted, not ribbed, rather thick-shelled.

IDENTIFICATION

This species seems to be practically identical in leaves and shoots with *Juglans mandshurica*, and differs little in these respects from *Juglans cordiformis*, except that the leaflets of the latter are distinctly cordate at the base. All three species differ, however, remarkably in fruit, and must be kept distinct on that account. They belong to the section of walnuts with bearded leaf-scars, and are readily distinguished from *Juglans cinerea*, the other species of this group, by having the leaf-scars deeply notched above.

In winter the following characters are available:—Twigs stout, brown, glabrous except near the tip, where the pubescence of summer is retained. Leaf-scars large, on very slightly raised pulvini, obovate, two-lobed above; upper margin convex, with a central notch, and surmounted by a raised band of pubescence; bundle-dots in three groups. Terminal bud brownish, elongated, covered with a dense minute pubescence; outer pair of scales lobed at the apex. Lateral buds arising at an acute angle, small, ovoid, pubescent; frequently two superposed. Pith large, brown, with narrow chambers and thick plates.

DISTRIBUTION

According to Maximowicz it occurs throughout the whole of Japan, there being large trees around temples at Hakodate. At Miadzi, in Kiusiu, it is wild on the sides of mountain streams, being a tree of about eighteen inches in diameter. It is also supposed to occur in the island of Saghalien, as nuts cast up by the sea were found there by F. Schmidt.

Sargent[1] says that *Juglans Sieboldiana* is a common forest tree in Yezo and the mountainous regions of the other islands of Japan. Specimens more than 50 feet high are uncommon. It is a wide-branched tree, resembling the butternut in habit and in the colour of its pale furrowed bark. The walnuts of this species are an important article of food in Japan, as the nuts are exposed for sale in great quantities in the markets of all the northern towns.

Elwes collected specimens at Asahigawa in central Yezo, and noted that it was always a small tree, 20 to 30 feet in height by a foot in girth. He also saw it near Nikko, but never of any size. It is called *Kurumi*. The wood, though used to some extent in Japan for gun-stocks and ornamental work, does not take a high place among the valuable timbers of the country. It was not included in the collection of woods exhibited at St. Louis.

CULTIVATION

Juglans Sieboldiana was introduced from Japan into Leyden about the year 1860 by Siebold, and was sent from there to Segrez in 1866, under the name of *Juglans ailantifolia*. At Segrez it passed unscathed through the severe winter of 1879-1880, which proved fatal there to the common walnut.

According to Sargent this species is perfectly hardy in New England, where it ripens its fruit. It is not worth growing there as an ornamental tree; but it will produce fruit in regions of greater winter cold than the common walnut can support, and may find some place in planting as a fruit tree.

The largest specimen we know of in these islands is at Belgrove, Queenstown, Ireland, the residence of W. E. Gumbleton, Esq. It was, in 1903, 24 feet in height by 2 feet 9 inches in girth. There are specimens at Kew about 12 feet high, which were grown from seed received in 1894. There is also a small plant at Gunnersbury House, Middlesex, which has borne fruit.

(A. H.)

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[1] *Forest Flora of Japan*, 60 (1894).

COMMON OAK

The following is an account of the three species into which the *Quercus Robur* of Linnæus has been divided :—*Quercus pedunculata*, *Quercus sessiliflora*, and *Quercus lanuginosa*. Brief notes are given also of certain Mediterranean and Oriental forms which are in cultivation. The generic character will be given in another part, with our description of the exotic oaks in cultivation in these islands. Plates 78 and 79 show the twigs and buds of the pedunculate and sessile oaks, as well as those of some other species which will be described in a later volume, and the leaves of the three species now treated and of some of their varieties.

Those wishing to have the latest information on the oak from a physiological point of view are referred to the late Prof. Marshall Ward's work,[1] which contains many details on points with which we do not propose to deal.

Loudon's account of the oak, covering over 100 closely printed pages, is also well worth study, especially with regard to the numerous historical trees, the quality of the timber, and the fungi, galls, and insects which live on or attack the tree.

QUERCUS PEDUNCULATA, COMMON OR STALKED-CUPPED OAK

Quercus pedunculata, Ehrhart, *Beiträge*, v. 161 (1790); Loudon, *Arb. et Frut. Brit.* iii. 1731 (1838), Boswell Syme, *Eng. Bot.* viii. 145, tab. 1288 (1868).

Quercus Robur, Linnæus, *Sp. Pl.* 996 (*ex parte*) (1753).

Quercus Robur, L., sub-species *pedunculata*, DC. *Prod.* xvi. 2, p. 4 (1864).

Quercus Robur, L., var. *pedunculata*, Hooker, *Student's Flora of the British Isles*, ed. 2, 364 (1878).

A large tree, attaining a height of over 100 feet and a girth of stem of 20 to 30 feet, with the main branches large, long, and irregularly bent.

Bark, when old, irregularly fissured, and gradually increasing to a thickness of two inches or more. Branchlets in winter stout, glabrous, angled, grey, with a five-angled pith and small semicircular leaf-scars, which are set obliquely on prominent leaf-cushions and show three irregular groups of leaf-traces. Buds brown, clustered at the ends of the twigs, and arranged alternately (in 2/5 order) lower on the twigs, arising at an acute angle; blunt-oval, five-angled, with numerous imbricated scales (in five rows), which are glabrous on the surface and shortly ciliate on the margin. The bud-scales are stipules, which fall off as soon as the leaves expand.

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[1] *The Oak*, by H. Marshall Ward, F.R.S. (1892).

Leaves deciduous, sessile or with very short stalks, extremely variable in shape and size, but never symmetrical, generally with four to five pairs of entire, irregular, rounded lobes; obovate-oblong, diminishing in size to the base, which has always *two small emarginate auricles*; slightly silky pubescent when young, quite glabrous when adult; coriaceous in texture; dark green above, bluish green beneath. *Some of the lateral nerves run to the sinuses between the lobes.* The leaves from suckers which are very rare are usually entire or only slightly lobed, and are not auricled at the base. The fall of the leaves is very slow, often continuing for weeks, and frequently a part of the leaves remain on the tree till the close of winter.

Flowers appearing with the leaves; the male catkins being pendulous spikes (each bearing about a dozen flowers) arising from the preceding year's shoot and the lower part of the current year's shoot; the female inflorescences being long, obliquely erect spikes (each bearing one to five flowers at the upper end) arising in the axils of the two or three uppermost leaves. Male flower: calyx five- to seven-lobed, enclosing five to twelve stamens. Female flower: calyx six-partite, surrounded by a scaly cupule and enclosing an inferior ovary, surmounted by a cylindrical style terminating in a trifid stigma. Ovary three-celled, each cell containing two pendulous ovules.

Fruits: one to five, sessile on an elongated glabrous peduncle (1 to 6 inches long). Cup hemispheric, composed of many appressed, triangular, obtuse, glabrous or slightly tomentose imbricating scales. Acorn: variable in size and shape, flattened at the base where attached to the cup, and bearing the remains of the style at the apex, smooth and shining, containing one seed in one cell, five ovules and two cells being aborted and only visible as shrivelled remains at the base.

SEEDLING

The cotyledons remain enclosed in the coats of the acorn, and are not lifted above ground. The caulicle, stout and dark-coloured, gives off a long woody primary root. The plumule arises between the petioles of the two cotyledons, and develops into the young shoot, which at first bears only a few scattered scales, the first green leaf, small and obovate-oblong, coming afterwards; those succeeding are larger, obovate, and lobed. By the end of the first season the seedling has a long primary root with spreading lateral rootlets and a glabrous stem, averaging 6 to 8 inches high, bearing five or six sub-sessile glabrous leaves spirally arranged and ending in an ovoid glabrous bud. Each of these leaves has a minute stalk, with a pair of tiny linear stipules.

Seedlings,[1] according to Brenner, who made many observations, vary considerably in appearance, according to the soil in which they are grown, those in dry ground having leaves with deeper lobes, ending in sharp points; those in moist earth having shallow undulating round lobes.

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[1] Brenner, *Flora* (1902), Band 90, p. 122.

VARIETIES OF *QUERCUS PEDUNCULATA*

1. Var. *fastigiata*, Spach, *Hist. Vég.* xi. 151 (1842), Fastigiate or Cypress Oak.

Quercus fastigiata, Lamarck, *Encyc.* i. 725 (1783).
Quercus pyramidalis, Gmelin, *Fl. Bad.* iii. 699 (1808).
Quercus cupressoides, Hort.

The Cypress Oak has the branches pointing upwards, which gives the tree an irregular fastigiate shape; but in foliage and fruit it does not differ from the common oak. It has been found wild in the south-west of France, in the Landes and Pyrenees, in the provinces of Galicia and Navarre in Spain, and in Calabria. A famous tree of this variety stood in 1876 near the village of Haareshausen, close to Babenhausen in Hesse, which was supposed to be 280 years old, and it then measured 100 feet high and 10 feet in girth.[1] It had been celebrated in Germany since the middle of the eighteenth century, and stood originally in the forest, now cleared away. From this tree nearly all the German trees, and possibly many English and French trees of this variety, have been derived. This variety comes true from seed to some extent; of thirty acorns sown at Nancy, twelve produced pyramidal oaks, the remainder reverting to the ordinary type. At White Knights, of several hundred acorns sown by the gardener, only five came true to the fastigiate type. Elwes has raised plants from seed which in youth at least are more or less fastigiate. The tree at White Knights is a remarkably good specimen, being 81 feet high and 8 feet in girth, and is beautifully symmetrical in shape. Sir Herbert Maxwell tells us that there are two trees at Dawick, Peeblesshire. Other fine specimens are at Knole Park, Kent, where Elwes measured one 66 feet by 5 feet; and at Hardwick, Suffolk, where he saw one 61 feet by 4 feet 10 inches. A very well shaped tree of this variety at Melbury Park (Plate 80) measures 65 feet by 3 feet 8 inches, and has the form of a well-grown Lombardy poplar. But none of these are equal to a tree growing at the Trianon at Versailles, which Elwes saw in 1905, and which measures about 90 feet by 10 feet.[2] Several sub-varieties have appeared in various nurseries, and have received names, but as we have seen none of these in cultivation we do not think them worth recording.

2. Var. *pendula*, Loudon, *Arb. et Frut. Brit.* iii. 1732 (1838), Weeping Oak. —In this variety the branches are pendulous. The most famous tree of this kind is at Moccas Court in Herefordshire; but it has now almost ceased to weep, and Elwes would not have been able to distinguish it if it had not been pointed out to him. The present owner, the Rev. Sir George Cornewall, writes that "weeping oaks are far from uncommon in Herefordshire," and showed

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[1] Petzold, *Deutschen Reichsanzeiger*, quoted in *Gard. Chron.* v. 51 (1876). See also *Gard. Chron.* xix. 179, fig. 26 (1883), where Mr. Wissenbach states that the oldest and finest specimens in Germany occur in the royal park at Wilhelmshöhe, near Cassel, the best measuring 100 feet high and 8 feet 6 inches in girth. It is 100 years old, being a graft of the original tree in the forest near Babenhausen. An earlier account of the latter tree is given by a correspondent in *Gard. Chron.* 1842, p. 36.

[2] A group of fine trees of this variety, said to be more than 100 feet in height, is reported to be growing in the park of Verdais in Haute Garonne. *Woods and Forests*, 105 (1884).

him a very striking one on the road from Moccas to Bredwardine, from the acorns of which seedlings have been raised. In 1884 there was a weeping oak at the King's Acre nurseries, Hereford, grafted at 3 feet up, which was planted by Cranston in 1785.[1] It bears acorns every year; but none of the seedlings, it is said, show a tendency to droop. The top of this tree is not pendulous; the weeping only occurs on the outer parts of the lower branches.

3. Var. *filicifolia*, Lemaire, *Illust. Hort.* i. t. 32, *verso* (1854), Fern-leaved Oak, also known as *asplenifolia*, *pectinata*, *pinnata*, *taraxacifolia*, etc. The leaves are stalked and cuneate at the base, long and narrow in outline, deeply and irregularly pinnatifid. This was found wild in the mountains of southern Germany; and was sent out by Messrs. Booth and Sons, Hamburg.

4. Var. *heterophylla*, Loudon, *Arb. et Frut. Brit.* iii. 1732 (1844), Various-leaved Oak. This variety has leaves varying greatly in shape; some are lanceolate and entire, others are cut at the edges or deeply laciniate; but all are cuneate at the base. It has received a variety of names, as *comptonæfolia*, *incisa*, *dissecta*, *laciniata*, *salicifolia*, *Fennessi*, *Fenzleyi*, *diversifolia*, *cucullata*, etc. Loudon's figure represents a branch from an accidental seedling, raised in 1820 in the nursery of Messrs. Fennessey, Waterford. There is a free-growing tree of this variety at Smeaton-Hepburn, East Lothian, which measured in 1905, 56 feet by 4 feet 8 inches.

5. Var. *hyemalis*, Bechstein, *Forstbot*, 333 (1810). In this variety the fruit stalk is very long, at least as long as the leaf itself. This is also known as *Quercus longipes*, Steven, *Bull. Soc. Nat. Mosc.* i. 385 (1857).

6. Var. *scolopendrifolia*, Hort. This form has leaves with short stalks and cordate bases, somewhat variable in shape. Most of the leaves are long and narrow, with short lobes; but others more angular in form have swollen bladder-like projections on their upper surface. Certain sub-varieties are distinguished as *bullata*, *cochleata*, *crispa*, etc.; all having leaves variously deformed and presenting bladder- or blister-like projections on their surfaces.

7. Var. *Concordia*, Lemaire, *Illust. Hort.* xiv. t. 537 (1867). Leaves yellow, much more brightly coloured than in the variety commonly cultivated under the name *aurea*, the colour persisting during the summer. This beautiful form, the *Golden Oak*, originated in the nursery of Messrs. van Geert at Ghent in 1843. The late Mr. Charles Ellis wrote in 1894 to Kew that some golden oaks occur at Inglewood, Hungerford, Berkshire, as bright as the golden elder when seen in May. Mr. Clarke, gardener to H. J. Walmesley, Esq., the owner, informs me that the trees are now in vigorous health, and measure at 6 feet from the ground 45 feet by 6 feet 2 inches and 40 feet by 4 feet 9 inches respectively.

8. Var. *purpurascens*, A.DC., *Flore Française*, vi. 351 (1815), Purple Oak. —This was found wild near Le Mans by De Candolle; and another wild tree was subsequently found in Thuringia. The young leaves, petioles, and branchlets are purple, the colour fading away later in the season. This form

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[1] *Woods and Forests*, 794 (1884), with a full-page engraving of the tree, which was reported to be 72 feet high and 8½ feet in girth.

has received many names, as var. *purpurea*, Loudon, and var. *sanguinea*, Spach. There are slight sub-varieties which are known as *atropurpurea*, *atrosanguinea*, *nigra*, *nigricans*, etc. The purple oak was first described by Bechstein (*Forst. Bot.* 333) in 1810 as *Quercus sanguinea*.

9. Var. *variegata*, Endlicher. Oaks with variegated leaves are not uncommon in the wild state. There is a specimen at Kew of a curious form sent by Mr. J. Lindsay Johnston from Eastlodge, Crondall, Hants, in 1882. The Rev. W. Wilks has sent leaves of an oak at Shirley, which were of a beautiful pink colour in November 1902. There are many forms of variegated oaks in catalogues; but it must be remembered that there is often a tendency in them to revert to the green form in a short space of time. Some of these sub-varieties may be distinguished as follows:—*argenteo-marginata*, margin of leaves white; *argenteo-picta*, leaves with white streaks; *aureo-variegata*, leaves with yellow streaks; *rubrinervia*, veins red in the young leaves; *aureo-bicolor* and *tricolor*, leaves variously coloured yellow, white, and green.

Elwes has seen a very fine variegated-leaved oak at Haldon near Exeter, the seat of J. F. G. Bannatyne, Esq., and I measured one 57 feet high and 7 feet in girth, at The Grove, Teddington, which, according to Loudon,[1] was 37 feet high in 1837. This tree bears leaves, which come out variegated green, white, and pink, changing in autumn to a pure pink colour. The present owner, Charles E. Howard, Esq., informed me that it fruited only once to his knowledge, in 1887.

An account is given in the *Gardeners' Chronicle* of 14th September 1861 of a common oak which became variegated, the result of having been struck by lightning. This tree grew near Mawley, the seat of Sir Edward Blount, and contained about thirty feet of timber. It was struck by lightning on 26th June 1838, and did not appear to suffer at the time; but shortly afterwards the foliage, which was previously green, became beautifully variegated, and continued to produce variegated leaves and remained healthy.

10. Var. *cuprea*, Hort. This variety has bronze-coloured leaves when young, and is said to be a very distinct and vigorous form.

11. Var. *tardissima*, Simonkai, *Le chêne de juin*.[2]—This variety has more regular branching and denser foliage than the common form; but is chiefly remarkable for the lateness of its leafing, which occurs five to eight weeks after the common oak. It was discovered in France in the valley of the Saône, from Pontailler to Saint-Amour; and has since been found at various places in the departments of Loir-et-Cher and Cher, and also in Hungary. It appears from experiments made at Nancy to come true from seed;[3] and the delay in the putting forth of the leaf is as marked in seedlings as in old trees. It grows vigorously; and apparently, in spite of the short period each season that it

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[1] Loudon, *Gard. Mag.* 1837, p. 10.

[2] For interesting accounts of this variety, the following papers may be consulted:—Gilardoni, *Le chêne de juin* (1875); Jolyet, *Bull. de la Soc. des Sciences*, 1899.

[3] But seedlings raised by Elwes at Colesborne from acorns sent from France by M. L. Pardé do not seem to retain the late-leafing habit.

carries foliage, it produces as much timber as the common form.[1] The variety is considered of some importance in France, as owing to the lateness of leafing it is never affected by spring frosts; and it is recommended for cold, damp situations where the common oak is injured by this cause.

Many other varieties doubtless occur, both in cultivation and in the wild state. Specimens were sent to Kew from an old oak tree at Springfield, West Wickham, Kent, which bore extremely large leaves all over the tree, measuring as much as 8 inches long and 6 inches wide, and similar leaves occur on a tree at Colesborne. At Tortworth there is an oak about fifty years old, which bears fruit on very long peduncles, and has remarkably glossy coriaceous leaves[2] somewhat variable in shape, but generally obovate-lanceolate, with quite entire or only slightly lobed margin. This is almost identical with a specimen at Kew, gathered near Arcachon in France by Mdme. de Vilmorin. Specimens collected in Wistman's Wood, Dartmoor, are also remarkable for their irregularly shaped and very slightly lobed leaves, which have a cuneate base.

The variation in the size and shape of the leaves in natural wild seedlings growing side by side is often remarkable. Elwes gathered from three trees growing on the rocks above Minard Castle, Lochfyne, leaves varying from about 2 to 8 inches long. Meehan[3] narrates that when he settled in Germantown, near Philadelphia, he found a single *Quercus Robur* on the grounds of Mr. J. Hacker, from the acorns of which he raised hundreds of young seedlings, and has from these a second generation. He found amongst the seedlings numerous varieties, *e.g.* trees with leaves quite sessile, others with a petiole ¼ inch long, others with leaves as entire as those of *Quercus Prinus*, others with pinnatifid lobes; while in some cases the acorns were only a little longer than broad, in other cases cylindrical and twice as long as broad. Evidently here there was no possibility of hybridisation, as there was only one tree. This experiment of Meehan's, however, only goes to show the extreme variability of *Q. pedunculata*; and there is no evidence brought forward that any of the varieties became in the least like *Q. sessiliflora.*

In all the preceding varieties we are treading on safe ground, as there is no doubt that they are all derived from *Q. pedunculata*; but the case is different with certain forms from the Orient and southern Europe, which were considered by De Candolle to be varieties of *Q. pedunculata*, but by other authorities are treated as distinct species. A brief account of such of these as are in cultivation in England follows:—

Quercus Haas, Kotschy, *Die Eiche. Eur. u. Or.* t. 2 (1862); *Q. Robur, pedunculata*, var. *Haas*, DC. *Prod.*—This oak occurs in Cilicia and the Taurus, and in habit and size resembles the common oak; it differs in the following respects:— Young shoots white pubescent, puberulous when adult. Buds finely pubescent. Leaves on very short pubescent stalks, obovate, with cordate base, and four or five pairs of rounded lobes, the lateral nerves reaching to the sinuses as well as to the lobes; coriaceous; under surface bluish green, with a stellate pubescence, often discernible only with a lens. Fruit: 2 to 6 on a long stalk, very large, the acorns being ⅘ inch in diameter. The cups look very distinct from those of the common oak.

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[1] Mathey, *Exploitation Commerciale des Bois*, 95 (1906), speaks of its timber as being excellent, with very little sapwood, and scarcely any defects.

[2] Figured in Plate 79, fig. 2.

[3] *Bull. of the Torrey Bot. Club*, ix. 55 (1882).

This species is considered by Zabel[1] to be a hybrid between *Q. pedunculata* and *Q. lanuginosa*, but it seems rather to be a geographical form of *Quercus pedunculata.* Elwes saw two stunted trees which may be this at Orton Hall, Peterborough, said to have been raised from acorns sent by the late Sir H. Layard from Kurdistan.

The following three species or geographical forms were considered to be varieties of *Quercus pedunculata* by De Candolle.

Quercus Brutia, Tenore, *Sem. Ann. Hort. Neap.* (1825), p. 12.—Occurs in southern Italy. The difference between it and some northern forms of *Q. pedunculata* is very slight, as the leaves are glabrous. The fruit is large and somewhat peculiar.

Quercus Thomasii, Tenore, *loc. cit.* This also occurs in southern Italy, and is a form with large acorns, having leaves pubescent on the under surface, and standing on short pubescent petioles.[2]

Quercus apennina, Lamarck, *Encyc.* i. 725 (1783).—This is a small oak which occurs on dry situations in the south of France, and is said to form considerable forests in the Apennines in Italy. It has hoary, tomentose shoots and small leaves, with the under surface pale pubescent, and shorter stalks than *Quercus lanuginosa*, which it otherwise much resembles. The fruit is crowded on thick grey tomentose axes, and the cupules are greyish tomentose with appressed scales.

Hybrid or Intermediate Forms.—Hybrids between *Quercus sessiliflora* and *Q. pedunculata* occur; but they seem to be rare in the wild state in England, and I have only seen two or three specimens which could not at a glance be referred to one or other species without doubt. The best name for the hybrid is *Quercus intermedia*, Boenn, in Rchb. *Fl. Germ.* 177 (1830). The type specimen of *Q. intermedia*, Don, obtained by Leighton in Wyre Forest, Shropshire, is true *sessiliflora.* Another specimen in the British Museum labelled *intermedia*, gathered in 1843 in Surrey, is *pedunculata*; in this some of the peduncles are rather short, but there is one fully developed peduncle of the usual length, and the leaves in no way differ from ordinary *pedunculata.* What is often supposed to be *intermedia* is, however, the common oak, bearing leaves with stalks of a moderate length. The word *pedunculata* is apparently a trap to deceive all but the practised botanist. In *Q. pedunculata* the acorns are sessile on a long peduncle, which is distinct from a shoot, as it bears only acorns, never buds or leaves. I have received specimens from professional foresters, labelled "*sessiliflora*, intermediate form," in which the peduncle bearing the acorns overtopped the end of the shoot, and was mistaken for it, and the acorns in consequence were considered to be sessile on the shoot. I think that the alleged occurrence of numerous intermediate forms is due to an imperfect appreciation of the real distinctions between the two species; and specimens to support the common occurrence of hybridity are not as yet forthcoming. The first writer who tried to break down the distinctions between the two species in England—Greville[1]—was not at all sure that he had succeeded; and in view of the important sylvicultural differences between the two trees the subject is one of more than academic interest.

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[1] *Laubholz-Benennung*, 78 (1903).

[2] Elwes has received seedlings of both these forms from Herr Sprenger of Naples, and has sent some of them to Kew; but they do not at present show any appreciable difference, which was the case also in the oaks which he saw growing in the Sila mountains in Calabria.

Certain cultivated forms may be hybrids, as, *e.g. Quercus falkenbergensis*; and *Q. armeniaca*, Kotschy, from Armenia, is an undoubted hybrid. (A. H.)

The question of the distinctness of the sessile and pedunculate oaks in England has been discussed at great length on many occasions, but is one on which opinions, even among careful observers, always have differed, and differ still. Perhaps the best account of their peculiarities and merits is given by Loudon, pp. 1737-46, and in the *Gardeners' Chronicle* (1900), when a discussion was opened by Prof. Fisher, and continued by other well-known authorities.

Prof. Fisher describes the physiological difference, and maintains the opinion, which, largely based on French experience, is confirmed in some parts of England, that the pedunculate oak is naturally adapted to a wet soil, while the sessile will thrive in comparatively dry situations, and says that these peculiarities are of great importance to planters in selecting seed. As nurserymen rarely distinguish them and are, as a rule, careless of the source from which their seed comes, provided it will produce good nursery plants, I should strongly advise all oak planters to select and grow their own oaks from the trees which thrive best on similar soil in their own district, or in places with similar soil and climate.

Mr. A. C. Forbes says that in many localities the sessile oak is quite rare, and in Wilts "probably the rarest indigenous tree that we have." He accounts for this by the fact quoted from a paper[2] by Mr. J. Smith of Romsey, that at the time when oak timber was in demand for the navy, the durmast oak was not considered fit for that purpose, being, as it was said by the purveyors for the navy, more liable to dry rot, and this tradition still lurks in the minds of the older woodmen, tales being told of how they deceived those worthy gentlemen into passing the durmast oak for the dockyards.

There is a great deal of very interesting information in this paper both on the rate of growth and effects of transplanting of oaks, on their insect enemies and fungoid diseases, and a list is given, with many particulars and measurements of many of the most celebrated oaks of England. No one who is interested in oaks should fail to read it, but it is too long to quote from as freely as I should wish.

Sir Herbert Maxwell, in *Gardeners' Chronicle*, Nov. 10, 1900, says: "The long correspondence in your columns relative to the merits of the durmast or sessile-flowered oak will probably leave most people of the same mind as they were when it began"; and goes on to say, "What is important is the fact that the durmast will thrive and ripen its season's growth in moist northern and western latitudes, which are unfavourable to the development of the pedunculate kind. In our salt-laden atmosphere upon the western seaboard much of the growth made by the pedunculate oak during one season fails to ripen before it is nipped by frost, and the tree is much more subject than the durmast to galls—a sure sign of debility; and it never carries with it the wealth of glossy foliage that never fails to distinguish the latter."

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[1] *Trans. Bot. Soc. Edin.* i. 65, tt. 4, 5 (1841).

[2] *Trans. Scot. Arbor. Soc.* xiii. 21 (1891).

He then speaks of the fine oaks at Merevale Park, which are described on p. 318, as being of the sessile variety, and says that at Knole Park, Kent, on the other hand, the general growth is pedunculate; but there is a magnificent avenue of durmast oaks, leading to the house from the direction of the Wilderness, and these tower far and straight above the gnarled and twisted veterans in the rest of the park.

Another peculiarity of the sessile oak is referred to in a letter from the Hon. Gerald Lascelles to Mr. Stafford Howard, in which he says: "I doubt whether there is much difference between the timber of the sessile and pedunculate oaks, but I think that the sessile is straighter and cleaner in growth, and one thing is certain—that it is almost immune from the attacks of the caterpillar (*Tortrix viridana*) which so often destroys every leaf on the pedunculate oak in early summer. Whether this does any real harm or not is a moot point, but I think it must be a check to growth, and that the trees would be better without it. I have seen a sessile oak standing out in brilliant foliage when every tree in the wood around was as bare of leaf as in winter."[1]

Mr. J. Smith, in the paper above referred to, pp. 29-30, confirms Mr. Lascelles' observations, and says that in 1888, which was the worst year for these caterpillars that he remembered, he passed through a wood composed of *Q. sessiliflora* in which, though it had been attacked by the caterpillars, they had left off, evidently either poisoned or starved. He also quotes a resident in the Forest of Dean who, writing in 1881, says: "It was strikingly evident last summer that the *Q. Robur pedunculata*, or old English oak, was attacked by blight (? caterpillars) more severely than *Q. R. sessiliflora*"; and Mr. Baylis, who now has charge of Dean Forest, writes to me on the subject as follows:—"I can confirm the statement that the larva of the green oak moth defoliates *Q. pedunculata*, very much more than *Q. sessiliflora*, and I think the reason is this: the latter is the first to come into leaf, and the leaf has time to get fairly tough before the caterpillar has reached its most destructive stage, which is about the time that *Q. pedunculata* is coming into leaf.[2] I have very frequently noticed this fact that the oak with more decided pedunculate characters is almost invariably attacked rather than the other."

The only published exact observation that I know of with regard to the relative rate of growth of the two forms on the same soil is by Mr. H. Clinton Baker of Bayfordbury.[3] Near his house are growing on sandy loam, close to each other, a pedunculate oak raised in 1811 from the celebrated tree at Panshanger, and a sessile

[1] Sir Herbert Maxwell remarks, *in litt.*, that though visitations of *Tortrix* are not common in Scotland, yet in June 1905 the oaks on the shore of Loch Awe and Loch Lomond, which are sessile, were stripped of their leaves by this pest.

[2] Usually *Q. pedunculata* is the first to come into leaf. Cf. p. 292.

[3] *Gard. Chron.* xxxvii. 132 (1905).

oak raised in 1840 from a tree at Woburn Abbey. Measurements show that the former was 6 ft. 7 in. in girth in 1865, and is now 9 ft. 4 in.; whilst the latter, only 1 ft. 8 in. in 1865, is now 8 ft. 7 in. Mr. J. Hopkinson in *Trans. Hertfordshire Nat. Hist. Soc.* xii. pp. 249, 250, gives diagrams showing the comparative annual increase during two periods of these trees. I may add that the habit of the two trees differs but little, and the soil is more suitable to the sessile oak.

Mr. Sharpe,[1] forester at Monreith, where Sir Herbert Maxwell planted in 1898 a quantity of oaks of the two species, on a fairly deep loam soil, measured ten of each sort in 1905, and informs us that the sessile oak averaged 13¼ feet in height, and the pedunculate oak only 10¼ feet. (H. J. E.)

QUERCUS SESSILIFLORA, SESSILE OR DURMAST OAK

Quercus sessiliflora, Salisbury, *Prod. Stirp. Hort. Chap. Allerton*, 392 (1796); Loudon, *Arb. et Frut. Brit.* iii. 1736 (1838); Boswell Syme, *Eng. Bot.* viii. 157, tab. 1289 (1868).
Quercus sessilis, Ehrhart, *Beiträge*, v. 161 (1790).
Quercus Robur, Miller, *Gard. Dict.*, vii. 1 (1759).
Quercus Robur, Linnæus, var. β; *Mantissa*, 496 (1771).
Quercus Robur, L., sub-species *sessiliflora*, DC. *Prod.* xvi. 2, p. 6 (1864).
Quercus Robur, L., var. *sessiliflora*, Hooker, *Stud. Flora Brit. Isles*, ed. 2, 364 (1878).

A tree resembling *Q. pedunculata*, but with more regular branching, resulting in a denser crown of foliage. It differs somewhat in the characters of the branchlets, buds, leaves, pistillate flowers, and fruit, as follows:—

Branchlets pubescent, especially near the top. Buds more sharply pointed, with scales pubescent on the outer surface, especially near the apex, and having long marginal cilia.

Leaves with a long petiole; symmetrical, obovate-oblong, widest at the middle and gradually diminishing to the base, which is cuneate and generally without auricles; firm, almost coriaceous in texture; sinuately lobed or pinnatipartite, the lobes being oblong or triangular, entire, occasionally apiculate; upper surface glabrous and shining, dark green; lower surface brighter even glaucous green and always more or less pubescent. *Lateral nerves running to the sinuses are very seldom present.* Pistillate flowers with stigmas almost sessile. Fruit solitary or crowded, inserted on the branchlets, or borne sessile on an erect, stout, short pubescent peduncle. Cups pubescent, with scales more numerous and more closely crowded together than in *Q. pedunculata.*

This species is quite distinct from *Q. pedunculata*, and the characters given above are very constant. The pubescence, which is visible in this species throughout, on the top of the twigs, buds, stalks, peduncles, cups, and under surface of the leaves, is not so pronounced in specimens occurring in rainy districts; but it can always be made out by a lens. The physiological differences are well marked. The sessile oak comes into flower and leaf later by some days than the other species, and it is less liable to attacks of the roller moth. It bears shade better, and on this account can be grown closer as a forest tree. It grows naturally on drier soils, and on the Continent ascends to higher altitudes than *Quercus pedunculata*. It is different in habit, the terminal bud being stronger than the others, so that the shoot is continued in the same direction, and the branches keep straight; whereas in *Q. pedunculata* the lateral buds at the apex often develop more vigorously and a crooked branch results, with the leaves much more tufted.

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[1] Cf. Sir Herbert Maxwell's account in *Gard. Chron.* xxxvii. 82 (1905).

SEEDLING

At first the seedling differs little from that of *Q. pedunculata*, though the young leaves are more distinctly stalked; but towards the end of the first year, the characters shown in the adult stage are well marked, namely:—the stem, leaves, and terminal bud are pubescent, and the leaves have a cuneate base and short but distinct stalks.

VARIETIES OF *QUERCUS SESSILIFLORA*

1. Var. *longifolia*, Dippel, *Laubh.* ii. 67 (1892).—This is also known as *macrophylla*. The leaves are variable, but are as a rule very long, as much as eight inches, and narrow in proportion to their length, the lobing being never constant. The base of the leaf is always cuneate.

2. Var. *laciniata*, Koehne, *Dendrol.* 130 (1893).—Leaves small with deeply-cut segments, which are directed forwards; base cuneate.

3. Var. *mespilifolia*, Wallroth, *Sched. Crit.* 494 (1822).—Leaves, with a petiole of one inch, lanceolate, long, and narrowed at both ends, averaging five inches long by one inch broad at the widest part; quite entire in margin or very slightly lobed. This form has been found wild at Nordhausen in the Harz mountains, at Wolgast in Pomerania, and in various places in Austria and Hungary. Var. *Louetti*, is a somewhat pendulous sub-variety, which is considered by most authors to be identical with var. *mespilifolia*.

4. Var. *sublobata*, Koch, *Dendrol.* ii. 2, 32 (1873). *Quercus sublobata*, Kitaibel, in *Schult. Oest. Fl.* i. 619 (1814).—This is nearly the same as the last variety, but the leaves are slightly and regularly lobed. It came into commerce from the Royal nursery at Geltow near Potsdam, and hence is often known as var. *geltoviana*.

5. Var. *cochleata*, Petzold et Kirchner, *Arb. Musc.* 630 (1864).—This resembles the common form, except that the edges of the leaf are curved upwards, so that the centre of it is rendered concave. It is said to be a free-growing variety.

6. Var. *afghanistanensis*, Hort.—This variety, as cultivated at Kew, has obovate leaves very similar to the common form, except that the lobes of the leaf are more shallow and more numerous, and its bluish under surface is covered with a fine pubescence which extends to the petioles. It is considered by Zabel[1] to be a hybrid between *Q. lanuginosa* and *Q. sessiliflora*. It was sent out by Messrs. Booth of

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[1] *Laubholz-Benennung*, 77 (1903).

Hamburg, who stated in their catalogue that it came from Afghanistan; but Petzold and Kirchner, *loc. cit.*, consider this origin to be improbable. What is sold under this name in some nurseries is *sessiliflora* or *Mirbeckii*.

7. Var. *iberica*, Hort.—This variety, as cultivated at Kew, has small oblong-ovate leaves, broad and cordate at the base, acute at the apex, with numerous small deltoid lobes, each terminating in a callous acute tip, the margins of the lobes being often turned downwards and inwards.

8. Var. *falkenbergensis*, Hort.—This has small dark-green leaves, broadest in diameter in their upper third, lobes few and broad, and the base generally cordate and auricled. The fruit is sessile or on short peduncles. It is very probably a hybrid between *Quercus pedunculata* and *Q. sessiliflora*.[1] This variety was found in 1832 in a wood at Falkenberg in Hanover, and was put into commerce by Messrs. T. Booth and Sons in 1837.

9. Var. *alnoides*, Hort.—This variety, as cultivated at Kew, has small leaves, not exceeding 2 inches in length, with about eight pairs of small lobes, the apex of the leaf being generally acute, the base cordate or cuneate.

10. Var. *pinnata*, Hort.—Leaves deeply pinnate, the sinuses extending almost to the midrib.

11. Var. *rubicunda*, Hort.—Leaves deep red, more especially in the early part of summer.

12. Var. *purpurea*, Hort.—Leaves purple, becoming green with reddish nerves in early autumn. This variety, according to Mr. Nicholson, is a thoroughly distinct and valuable ornamental tree.

13. Var. *variegata*, Hort.—Leaves variegated either with white or yellow tints.

14. Var. *aurea*, DC. *Prod.* xvi. 2, p. 9 (1864). *Quercus aurea*, Kitaibel, in *Reichb. Icon.* xii. 8, t. 645 (1850).—The leaf has generally six pairs of deeply cut lobes, rounded at the top. The young shoots bear yellowish leaves, and are themselves deep yellow. This occurs wild in Austria, and is considered by Zabel[2] to be a hybrid between *Q. conferta* and *Q. lanuginosa*; but a type specimen at Kew does not show evidence of *Q. conferta* parentage.

15. Var. *dschorochensis*, Hort.—The variety which is cultivated under this name does not seem to be the species[3] found by Koch on the Dschoroch range of mountains near Trebizond in Asia Minor; and at Kew is apparently a form of *sessiliflora* with oblong-oval leaves, which have eight or nine pairs of very shallow sinuate lobes.

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[1] Zabel, *loc. cit.* 79.

[2] *Ibid.* 77. It is *Quercus aurea*, Wierzbicki, of Kotschy, *Eichen*, t. 4 (1862).

[3] *Quercus dschorochensis*, C. Koch in *Linnaea*, xxii. 328 (1849); *Quercus sessiliflora*, var. *dschorochensis*, DC. *Prod.* xvi. 2, p. 9 (1864).

QUERCUS LANUGINOSA, Pubescent Oak

Quercus lanuginosa, Thuillier, *Flora Envir. Paris*, ed. 2, 502 (1799).
Quercus pubescens, Willd. *Sp. Pl.* iv. 450 (1805).
Quercus Robur sessiliflora, var. *lanuginosa*, DC. *Prod.* xvi. 2, p. 10 (1864).
Quercus sessiliflora, Salisbury, var. *pubescens*, Loudon, *Arb. et Frut. Brit.* iii. 1736 (1838).

A small tree, rarely attaining 60 feet in height, and often, in the wild state, a dense shrub with a twisted stem. Bark rather rougher and more scaly than that of the common oak. Twigs and buds densely pubescent, the scales of the latter being ciliate on the margin and pubescent all over their surface. Leaves small, about 3 inches long, variable in shape, wrinkled in margin, cuneate or cordate at the base, with four to eight pairs of rounded lobes variable in depth; always densely pubescent underneath; petiole tomentose, ½ to 1 inch long. Axis of male flowers pubescent. Female flowers with sessile stigmas and tomentose ovary. Fruits, one to four, crowded on a short thick stalk, or sessile; cups tomentose and often tubercular.

This oak occurs on dry soils, especially those of limestone formation, in the south of France, Corsica, Spain, Portugal, Italy, Alsace, south Baden, Thuringia, Austria, Hungary, southern and western Switzerland, Turkey, Greece, Crimea, Caucasus, and Asia Minor. In Provence it forms dense, low thickets covering extensive areas of the very dry lower parts of the limestone mountains. In Corsica it appears to be the only deciduous species of oak; and was seen by me forming scattered groves in the mountains below the zone of *Pinus Laricio,* at about 2000 feet elevation. I observed no trees larger than a foot in diameter; and it is evident that it is very distinct from *Q. sessiliflora*, which, if it occurred, would grow to a large size in the Corsican humid climate. The tree is of no importance in Corsica as a source of timber; and Mr. Rotgès of the forest service considered that it should always be treated as coppice.

It produces hybrids with both *Q. sessiliflora* and *Q. pedunculata*, and differs markedly from both these species in its habit of producing root-suckers, and moreover the bark is different.

Loudon incorrectly states that it occurs in the New Forest, and Sussex. There is a tree of this form growing at Syon with a remarkably curved bole of about 18 feet long and 5 feet 10 inches in girth. If upright this tree might have been 50 feet high. Elwes has seen this species growing wild in the forest of Fontainebleau, which Hickel informed him was about its northern limit as a wild tree; here it is usually small and stunted, so far as he saw, and of no economic value.

Varieties of *Quercus lanuginosa*

1. Var. *Hartwissiana,* Hort.[1] Leaves with six or seven pairs of lobes, which are mucronate at the tips.

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[1] According to Schneider, *Laubholzkunde*, 194 (1904), the plant so named by Steven in *Bull. Soc. Nat. Mosc.* 1857,

2. Var. *dissecta*, Hort. Leaves deeply cut.

3. Var. *Dalechampii*, Koch, *Dendrol.* ii. 2, p. 38 (1873); *Quercus Dalechampii*, Tenore, *Ind. Sem. Hort. Neap.* 1850, p. 15; *Quercus sessiliflora*, var. *Tenorei*, DC. *Prod.* xvi. 2, p. 7 (1864).

This form, which is considered by some to be a distinct species, occurs in southern Italy. It is in cultivation at Kew, and has leaves 3 to 4 inches long on short stalks. The leaves are oblong-oval, with bases cuneate or truncate, often auricled, coriaceous in texture, shining green above, bluish and only slightly pubescent beneath, with six to eight pairs of acute shallow lobes, which have their margins curved inwards and backwards. The bark of the tree is very rough and scaly.

i. 387, is either a form of *Q. macranthera* or a hybrid of that species. The plant, however, usually cultivated as *Hartwissiana* is probably a variety of *Q. lanuginosa*, which Steven collected and described as *Q. crispata* (*Bull. Soc. Nat. Mosc.* 1857, i. 386).

DISTRIBUTION OF THE COMMON OAK

Owing to the general opinion of English botanists that there is only one indigenous species of oak, with two inconstant varieties, there are few accurate records of the distribution of the two species, and in the majority of cases it is impossible to say whether the specimens in our great herbaria are from wild or cultivated trees. Moreover, owing to the great changes caused by the spread of cultivation and the cutting down of most of the original woodland, the correct distribution of the two species can scarcely be made out. It is probable, however, that in ancient times the pedunculate oak occupied the alluvial lands and the better soils, now almost entirely devoted to agriculture and pasture. Hedgerow trees are invariably of this species. The sessile oak occupied the hilly land and the poorer soils; and in existing oak-woods occurring in such situations, which have never been touched by the plough, it is always the species met with, as in the Wyre Forest, the Forest of Dean, in the district about Burnham Beeches, in Lord Cowper's woods near Welwyn, Herts, which are on high-lying poor gravel soil, etc. In Scotland, judging from a specimen at Kew, the famous Birnam wood consisted of *Quercus sessiliflora*.[1] In Ireland, the ancient wood of Shillelagh, in Wicklow, of which a remnant still exists, was the same species. The Cratloe wood near Limerick is of pure sessile oak; and it is the only species in the wilder parts of Kerry. All the specimens of *Q. pedunculata* which I have received from Ireland, are from planted trees.

In England the oak ascends to 1200 feet in Yorkshire. In an interesting paper by H. B. Watt on the "Altitude of Forest Trees in the Cairngorm Mountains"[2] in Scotland, 700 to 800 feet is given as the highest level at which the oak was observed; but Mr. Watt says, in a MS. note, that he found in July 1903 a small oak at Corriemulzie at an elevation of 1200 feet. The same author gives many interesting particulars of the oak in Scotland, in a paper published in the *Annals of the Andersonian Naturalists' Society*, ii. 89 (1900). In Ireland the oak ascends in Derry to 1480 feet. There are remains of virgin forest in Donegal, on Sir Arthur Wallace's property near Lough Esk; and a very large oak wood, which is of great antiquity, occurs at Clonbrock, the seat of Lord Clonbrock, in Co. Galway, on the limestone formation. There are smaller woods in many of the mountain glens, and Mr. Welch of Belfast says that where these primitive bits of forest have never been touched by tillage, peculiar and local forms of land-shells occur, and the Clonbrock oak forest contains rare plants, moths, etc., unknown elsewhere. The oak was in early times much more widely spread; it has been found, *e.g.*, in a peat moss in the Orkneys. Mr. T. T. Armistead[3] found a young oak growing in a sheltered ravine on the coast of Hoy, Orkney, and the acorn from which it sprang must have been brought from the mainland by a rock-dove or rook.

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[1] Mr. Steuart Fothringham of Murthly confirms this by leaves from the large oak behind the Birnam Hotel at Dunkeld, which Hunter says is one of the few survivors of the Great Birnam Wood.

[2] *Cairngorm Club Journal*, iv. 111 (1903).

[3] *Zoologist*, 1891, p. 19.

Remains of oak are found in all the later geological deposits; in the pre-glacial deposits in the Cromer forest-bed; in inter-glacial deposits in Hampshire, Sussex, Hertford, Middlesex, and Suffolk; in neolithic deposits; common in "submerged forests" everywhere; at the base of peat-mosses in many localities (ascending in them up to 1000 feet in Yorkshire).[1] Mr. S. B. J. Skertchley describes[2] the growth of five successive oak forests in the valley of the Ouse, and considers the oldest of them to be some 70,000 years old. These forests spread downwards towards the fen till checked by water and peat moss, the latter eventually burying and preserving them. The trees in thousands lie to the north-east, having been blown down by the south-west, which is still the prevailing wind. The word oak occurs in place-names both of Celtic and Saxon origin, the Saxon forms in names being ac, oak, wok, and auch. These forms are illustrated by names like Auchley, Auckland, Acworth, Wokingham, Oakingham, Oakham, Oakfield, Oakley, Martock, Holyoak, and Selly-oak. The Gaelic name is *dair*, as in Derry, Edenderry, Ballinderry, Kildare, Adare, Darnock, Kildarragh, Auchindarroch, Craigandarroch.

Quercus pedunculata, according to Willkomm, occurs throughout the greater part of Europe, Asia Minor, and the Caucasus. Its northern limit reaches, on the west coast of Norway, 62° 55′, on the eastern side of Norway 60° 45′, in Sweden 60°, in Finland 61° 30′ at Björneborg and 60° at Helsingfors, then passes along the coast of Esthonia to St. Petersburg, and crosses Russia south of Jaroslav and Perm, then descends southwards, reaching the Ural river between Orenberg and Orsk, and descends along that river to Iletzkoi. Its distribution in the Caucasus and Asia Minor is not known with exactness, owing to the conflicting opinions about the oaks of these regions. In Europe it occurs as far south as Greece, Sicily, and in the Peninsula reaches its southern limit in the Sierra Morena range. The western limit, beginning at the western part of this range, includes the northern part of Portugal and Galicia, and continues up along the coast of France, ending in Ireland and Scotland. It is essentially a tree of the plains and low hills, but it ascends in Southern Scandinavia to 993 feet, in the Berne Oberland to 2530 feet, in the Tirol to 3160 feet, in the Jura to 2216 feet, and in the Pyrenees to 3300 feet.

It is, according to Max von Sivers,[3] a much scarcer tree than it formerly was in the Baltic Provinces of Russia, and only exists in pure forests of any extent in Kurland, where it attains in river valleys and loamy soil very large dimensions, as much as 9 metres (about 30 feet) in girth. Some of the best trees produce logs free from branches over 60 feet long and 5 feet in girth at the top. He attributes its comparative scarcity at present to over-felling during the last two centuries, but states that replanting has been recently carried on to some extent.

Quercus sessiliflora occupies a more restricted area than the other species. Its northern limit is 60° 11′ in Norway, 58° 30′ in Sweden; it then passes through east Prussia, Lithuania, and crosses the central provinces of Russia, Minsk, Mohilev,

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[1] C. Reid, *Origin of the British Flora*, 145 (1899).

[2] *Fenland, Past and Present*, chap. xv. (1878).

[3] *Die Forstlichen Verhältnisse der Baltischen Provinzen*, 1903.

Tula, and Penza, to Sergievsk near the southern Ural, in lat. 54°. The eastern limit commencing here, extends southwards, taking in the Crimea and Cilicia in Asia Minor. The southern limit extends through Greece, southern Italy, Sardinia, Catalonia, and the northern provinces of Spain to Asturias.

As a wild tree it does not occur in low-lying plains and alluvial ground; but is met with on the hills and lower ranges of the great mountain chains of Europe. It ascends in Hanover to 1900 feet, in the Alps to 3900 feet, in the Carpathians to 3300 feet, and in the Pyrenees to 5300 feet. In all these localities it ascends considerably higher than the pedunculate oak, reaching, *e.g.*, in the Alps 1500 feet higher than that species. (A. H.)

Propagation and Culture

The oak produces acorns in great abundance in some seasons,[1] generally about one year in three; but this varies very much in different parts of the country; and, so far as I have noticed, fruit occurs oftener and more abundantly in the south and west of England. It begins to bear at a very early age in some cases; and I received, in 1906, a packet of acorns from Miss Woolward, which she assured me were taken from oaks only ten years old from seed. Mr. Emerton, the head gardener at Belton Park, Notts, where they grow, confirms this. In the same season I saw acorns on the Billy Wilkin's Oak, which must be 700 to 800 years old; and was told that the Cowthorpe Oak, which is possibly much older, still bore a few. Acorns are greedily eaten by all domestic animals, but are injurious to cattle if taken in very large quantities.[2] Pheasants and pigeons also consume a great many, and rooks are credited with dropping most of the acorns which so often spring up as seedlings in places far from their parent tree.

The raising of oaks from seed is so easy, and the plants obtained are, as a rule, so much superior to what one can buy, that no one who wishes to plant them should fail to try the experiment by selecting acorns from the best oaks in the neighbourhood. These ripen in October, and should be gathered from the ground as soon as they fall, as dry as possible. They will not keep if stored damp, and my own experience is that they make stronger growth the first year if sown as soon as gathered, because the radicle will then bury itself deep in the ground before winter, and the germination will take place earlier. But if it is desired to sow the acorns where the tree is to grow, they must be protected against mice, rooks, pheasants, and wood-pigeons, all of which are very fond of them. Red lead or paraffin is sometimes used, but the latter is liable to injure the acorn, and it is said that chopped furze placed over the acorn is the best means of protecting them against mice. They should be covered with at least an inch of soil, and, if dibbled, care must be taken that they do not fall in the hole end downwards, but lie on their side in their natural position.

In 1901 I made experiments on the growth of oaks from acorns produced by many trees in different parts of England, in order to learn whether the size of the acorns and the vigour of the parent tree had much influence on their strength. I have now watched the growth of these young trees for six seasons, and have arrived at no definite conclusion, though I am much surprised by two facts which have become evident. Lord Ducie has an oak in his park which usually produces acorns of unusual size, some that he has weighed being only 36 to the pound. The plants from these were no stronger than those of normal acorns; and some of the very finest plants that I raised were produced by the small acorns of a very stunted grafted tree with variegated leaves, which I only sowed to see whether any variegation would appear in their leaves. I found, however, that on the average the acorns gathered on my own place on similar soil gave the best results, and that those from Hants and Kent did not produce such good seedlings as those from Nottinghamshire.

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[1] I saw a large oak on the lawn at Marks Hall, Essex, which produced no less than 31½ bushels of acorns in 1906.

[2] Mr. T. P. Price, of Marks Hall, told me that in 1904 ten bullocks died there from this cause.

The shoot appears above ground about the time the oak comes into leaf, or rather sooner, and the first growth is completed in three weeks or a month. A second growth, corresponding to the summer shoots of the parent tree, is produced in July or August, and sometimes even a third shoot. If sown in a nursery-bed they will be 4 to 12 inches high at the end of the first season, and should be transplanted in the following spring before they are a year old. For if the tap root is not cut early it will become so long and strong in good soil that the transplantation is a severe check to the young tree.

When lined out in the nursery they must remain two years longer, in good soil kept clean, after which the best of them should be 2 to 3 feet high and fit to plant out permanently, except where the herbage is long and coarse. They are sometimes left three years, but this is too long, though, where the land they are to go to is good and not too heavy, liberties may be taken with oaks which could not be risked on poor soil. If not planted out at three years they should be transplanted once more in the nursery, and at five or six years old ought to be 4 or 5 feet high, whilst oaks sown *in situ* in land covered with herbage or weeds will at the same age often be not more than a foot high and much less strong. In the long run, however, those which have never been transplanted will probably pass the others when once they have established a good root system, which in poor soil is a very slow process. Transplanted oaks, if they do not come away with good straight leaders, are best cut down to the ground the second or third spring after they are planted, when their roots are sufficiently established to throw up a strong leader. Some say[1] that this should not be done until the beginning of June when the sap is running strongly, but experiments which I have made seem to prove that April or May is better. Mice are the worst enemies of young seedling oaks, and where they are numerous cause an immense deal of damage by barking and biting them off close to the ground.

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[1] Hayes states, *Planting*, 160 (1794), that from long observation he can aver that the root of an oak never produces a growth of finer young wood than when the tree is felled about the first week in June, when the sap is flowing most freely, and refers to Marshall's *Minutes of Agriculture and Planting in the Midland Shires of England* for evidence in support of this opinion.

Billington's account of the immense losses which were caused by mice to the oaks sown in the Forest of Dean, which is quoted at length by Loudon, pp. 1805-7, shows that in places where mice are numerous it is more economical to plant than to sow; and I have on my own property failed to get anything like a good stand of young oaks by sowing, on account of the ravages of mice and rooks, though every precaution which experience could suggest was taken. I tried dibbling in wheat, and sowing in lines and patches, both on cultivated and uncultivated ground, and have only partial or complete failures to record. In better and lighter soils, and especially in woods of large size where rabbits are kept down, I have seen splendid results from self-sown acorns; and Mr. A. C. Forbes's prize essay on the natural reproduction of woods from seed, published in the *Transactions of the English Arboricultural Society*, v. 239, should be consulted, as well as Loudon's remarks on the same subject, pp. 1804-5.

Mr. Stafford Howard, C.B., who probably knows more about forestry and has done more to improve the management of the Royal Forests than any Commissioner who preceded him, except, perhaps, Lord Glenbervie, has sent me an excellent photograph of a grove of self-sown oaks on his property at Thornbury Castle, Gloucestershire, which has originated from acorns, self sown, in what used to be an osier bed, and which are now about thirty to forty years old. Plate 81 shows their present appearance. On December 29, 1904, Mr. Howard showed me this grove, of which about an acre, containing 139 trees, has been wired in and under-planted with beech at about 6 feet apart. Six trees have been measured and marked with the object of showing whether the future increase of the oaks will pay for the cost of under-planting. As I am not aware that this practice, which in Germany and France is considered good forestry, has ever been properly tested in England, I hope that the results of this experiment will be recorded.

The best illustration of the possibility of converting coppice with standards, into pure oak wood, was shown me in 1900 by Mr. A. C. Forbes in a wood called Derry Hill, on the property of the Marquess of Lansdowne, three miles from Chippenham. In this case the coppice was cut early in the winter, after a good crop of acorns, and completely cleared before the following May. The constant presence of workmen faggoting and cleaning the coppice, not only kept away pheasants and pigeons, but also buried a good many of the acorns; and the soil being suitable for oaks, their growth was so good in the next three years that by cutting away the shoots of the coppice wherever it crowded and overgrew the young oaks, a stand was obtained far thicker, cleaner, and more vigorous than I have ever seen from planted trees. If carefully attended to until the seedlings overtop and smother the remains of the underwood, and provided also the remaining standards are cut and removed before they damage the seedlings, I should expect this wood to become one of the best of its sort in England.[1]

On the property of Dr. Watney, at Buckhold, Berks, I have also seen some admirable illustrations of the growth of young oaks from seed, and of the result of converting oak coppice wood into standards, by leaving all the best poles uncut, and carefully thinning out the weakest at intervals. This process, owing to the great fall in the value of oak bark, to the production of which large areas of oak coppice in the west and south-west of England were mainly devoted, has become very generally desirable; but if the stools are old, it is best to grub them, and replant the ground with seedlings mixed with other trees, as has been largely done on the estates of the Duke of Bedford near Tavistock.

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[1] On revisiting the place seven years later I found that the growth had not been so good as it promised to be, owing perhaps to the underwood being cut too hard, and the soil having become overgrown with grass.

With regard to the effect of transplanting oaks on their future growth and height, opinions differ as much as on any subject. The late Sir James Campbell, who managed Dean Forest for many years, often told me that the oftener you transplanted an oak the better it grew, and he communicated a paper with measurements of some trees in Dean Forest to the International Forestry Exhibition at Edinburgh in 1884 in proof of this; but Mr. Smith, who quotes and refers to these measurements in the paper on oaks above referred to, agrees with me that they do not prove the case; and Mr. Philip Baylis,[1] who succeeded Sir J. Campbell at Dean Forest, writes me as follows:—

"At one time I was of the opinion, founded on the above measurements, that trees were benefited by being transplanted, but have long ago given up that opinion. It is true that for a time after the tree has recovered from the shock of moving, you may, in consequence of the greater number of fibrous roots produced by the moving, get a stimulated growth; but I am convinced that the tree which eventually produces the finest timber tree is the one which is never moved from the place where the seed first germinated."

In this opinion I entirely agree, and believe that though oaks, like other trees, may be drawn up to a considerable height when surrounded closely by other trees, especially the beech, yet that their straight upward growth largely depends on the depth to which the main roots can descend. I do not know that it has ever been proved at what age the tap root decays, and this no doubt depends very largely on the subsoil; but though one may see very large spreading oaks on a thin soil, I never saw a very tall and straight one except on deep land.

In an appendix to the First Report of the Commissioners of Woods and Forests, published as a blue-book in 1812, will be found (p. 143) some very interesting and valuable observations on the sowing and transplanting of oaks, in which instances are quoted from several places which go to show that oaks on some soils at least, as at Moccas Court, in Bere Forest, and in the Forest of Dean, will grow as fast or faster when transplanted at 8 to 10 feet high, or even more, than when sown *in situ*.

In another appendix to the same report, on page 141, are some further observations, made by men of great experience on the growth of oaks from the stool, which prove that when the stools are young and sound and the land good, sound oak trees of as much as 160 cubic feet may be so produced; but that when the stool has become old and partially decayed, or when the land is poor, such shoots are not likely to attain any size. The best example I know of an oak wood produced entirely from stools is one below the approach to Carclew in Cornwall, which the late Colonel Tremayne showed me in 1902. Here the trees average 15 to 20 feet apart, and have clean boles 25 to 30 feet high, and are about 4 feet in girth.

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[1] Mr. Baylis sends me a very interesting photograph showing the difference between the roots of transplanted and untransplanted oaks.

Marsham's opinion on the growth of oaks, taken from a paper printed in the *Philosophical Transactions*, are so much to the point, and his personal experience was spread over such a very long period (from 1719 to 1795) that I quote him as follows:[1]—

"In 1719 I had about two acres sowed with acorns, and from 1729 to 1770 I planted oaks from this grove, always leaving the best plants standing for the future grove; but most of the transplanted trees are already larger than those that were not removed; the largest of which is now (1795) but 5 feet 6 inches 8 tenths in circumference; and the largest transplanted tree (which was planted in 1735) is 8 feet 8 inches 7 tenths, viz., near 38 inches gained by transplanting in 60 years. And in beeches from seed, in 1733, the largest is now (1795) but 6 feet 9 inches; and the largest transplanted beech is 7 feet 5 inches 1 tenth, viz., 8 inches larger, although the transplanted beech is eight years younger than that from the seed. This proves that it is better to plant a grove than to raise one from the seed. The expense of planting is inconsiderable, and the planted trees are full as good and handsome, and many years are saved, besides the extra growth of planted trees. But this extra growth will not prove near so great in groves as in single trees. The first grove I planted from these acorns of 1719, was in 1731. In 1732 I made another grove from them, and in 1735 I planted a third grove from them, and in 1753 the last considerable number of plants were taken from the grove, and these are very good trees: so thirty-four years may be saved. But I would by no means advise the planting trees so large, as the trouble and expense will be too much, unless where a shelter or screen is wanted.

"Whether a grove is to be raised from seeds or planted, it is advisable to shelter it round; if from the seed, with such sorts as will grow quicker; and if by planting, with larger and taller trees. The soil in Norfolk is unfavourable to elms; therefore in planting I will venture to recommend hornbeams, as they may be planted large trees. I planted some hornbeams (rather large) in 1757, and, disliking their situation, in 1792 I removed them when they were about three feet in circumference, and did not lose one tree; and they made shoots of near half a yard that year; but I ought to say I cut off their heads.

"Before I quit this subject, I will presume to recommend, if young oaks are unthriving, there is reason to hope they may be helped by cutting them down to a foot or six inches; for in 1750 I planted some oaks from my grove of 1719 into a poorer soil, and although they lived they were sickly; so in 1761 I cut most of them down to one foot, and then by cutting off the side shoots, in three or four years led them into a single stem, and most of them are now thriving and handsome trees, and you can hardly see where they were cut off, and some are four feet round; and I have used the same method with unhealthy chestnuts, beech, hornbeam, and wych elm, and with the same success."

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[1] *Phil. Trans.* 1797, pp. 128-152.

RATE OF GROWTH

The rate of growth in the oak is principally governed by the soil and situation, and varies so much that any estimates of its possible increase are of little value unless based on local experience. We often read calculations of the profits of planting, drawn from Continental experience or from exceptionally favourable cases in England, which are very misleading and greatly in excess of reasonable expectations, and there is no tree to which these remarks apply more strongly than to the oak.

Few plantations give more ample proof of this than those made by the Government in the woods at Alice Holt, which were planted between 1810 and 1830, with the object of providing timber for the navy, and which were no doubt done by experienced planters. But the growth has been so poor that, when I visited them in 1905, in company with Mr. Stafford Howard and Mr. Lascelles, we saw but few oaks which looked as if they would ever be fine trees, and their average value was not much over 10s. per tree. In one place, called Willow Green, oaks of seventy years old were not over 30 or 40 feet high and not thick enough for gate-posts.[1]

In many parts of the Forest of Dean the results are not much better, and are largely attributed to over-thinning, and to the fact of the ground being thrown open to grazing too soon; but the soil and spring frosts must also have had a good deal to do with it.

In the New Forest the results are better, but not at all equal to what might have been expected. I am indebted to Mr. Stafford Howard for the following information on some of these plantations and the way in which they were made:—

Planting in the New Forest.—In order to make provision for the future needs of the navy, in view of the fact that planting had been greatly neglected in the New Forest, an Act was passed, 9 & 10 Will. III., for that purpose. Under this Act it was provided that 2000 acres should forthwith be enclosed and planted with timber for the use of the navy only, underwood and all other produce being excluded; that 200 acres should be enclosed annually for twenty years following, and that as soon as any of the land thus enclosed was safe from damage from cattle, it should be thrown open and a like area enclosed in its stead. The plantations described were made under the powers of this Act.

The precise form of cultivation employed was as follows:—

"Pits or beds of three spits of ground each were dug a yard apart, and three acorns planted triangularly in each bed. Half a bushel of acorns was allotted for each person to plant in one day. Two regarders attended every day during the time of planting to see that it was properly done; and after the ground was fully planted with acorns it was sown with haws, holly berries, sloes, and hazel nuts, drains were cut where necessary, and traps were set to catch mice, and persons attended daily to reset the traps and to keep off crows and other vermin."

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[1] Mr. Howard says that in the lower part of the Goose Green enclosure, and in the Straights, there is much better timber, and that in Dr. Schlich's report on these woods over 300 acres were classified as good, where the trees attain a mean height of 60 feet.

Whether from subsequent neglect or not, the plantations thus formed were never thinned at all, but allowed to grow up like a nursery quarter. Although contrary to every theory of plantation management, it cannot be denied that they were in this bad soil successful in growing a heavy crop of oak timber on moderate land.

Denny Enclosure.—There are some very good examples of natural regeneration in places in this wood, which was reinclosed in 1870. A photograph was sent which contrasts the young growth inside the fence of the enclosure with the bareness of the outside where the cattle graze.

Salisbury Trench.—This plantation was made in or about the year 1700, and measures about 100 acres. It was thrown open under an order dated 20th August 1807. It is calculated that there are now left after frequent thinning about sixty trees to the acre. Two years ago it was reinclosed with a view to its gradual regeneration, and there is already a large number of young oak and beech coming up in the open spaces.

North and South Bentley.—These plantations were made about the same time, probably just before that of Salisbury Trench, and are of the same character, except that there is some beech here and there in North Bentley. During the past twenty years the trees felled in Salisbury Trench, being for the most part the poorest ones, have averaged 23½ cubic feet; and there now remain about sixty to the acre. In North Bentley they have averaged about 25 cubic feet, in South Bentley 29 cubic feet, and about sixty trees to the acre remain standing.

One of the best private oak plantations of which the exact age is known is on the property of Lord Kesteven at Banthorpe, near Casewick, Lincolnshire. It was made by Sir John Trollope, grandfather of the present owner, in 1800, with acorns which had to be sown a second time, as they were eaten by mice in 1799. It is on good soil, and, as near as I could judge by the eye, contains about sixty trees to the acre, straight for the most part, and clean up to 30 to 40 feet. In 1905 twelve average trees in the plantation had an average timber length of 34 feet, an average quarter girth of 18 inches, and contained 903 cubic feet without tops or branches, which would make my rough estimate of 5000 feet to the acre very nearly correct, and if profit alone were considered I should say that these trees had now reached the proper age for felling.

The late Mr. John Clutton, who valued timber for the Crown for many years, gave,[1] in 1873, particulars of the size of oaks.

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[1] *Transactions of the Surveyors' Institution*, 1873-74, vol. vi.

In New Forest, Aldridge Hill, planted 1813:—

	Number.	Contents.	Value.
1st acre	75	742	£90
2nd ,, ...	79	559	67
3rd ,, ...	77	641	78
4th ,, ...	72	683	84
In Alice Holt Woods:—			
Lodge Enclosure	40	837	100
Goose Green	50	812	97
Berewoods, planted 1816 . .	54	771	93
,, ,, ,, . .	70	618	74
In Dean Forest:—			
Blakeney Hill, South, planted 1814 .	72	720	87
Nag's Head Plantation ,, ,, .	97	425	57
Bromley Hill Plantation ,, 1812 .	67	700	84
High Meadow Woods (no date stated), 1st acre	30	1528	214
High Meadow Woods (no date stated), 2nd acre	50	1480	207
In Richmond Park:—			
Upper Pond, planted 1824 . .	60	672	81
Kingston Hill, ,, 1826 . .	46	628	75
Isabella, ,, 1831 . .	68	450	54
Isabella, ,, 1845 . .	110	406	49

In the same volume Mr. Ralph Clutton, in an excellent paper on the self-sown oak woods of Sussex, gives many exact details of the growth of oak without underwood, with measurements and valuations, which should be consulted by all landowners in that part of England.

Under more favourable circumstances, however, oak plantations may yield a good profit, as shown by the following extract from the *Norfolk Chronicle*, sent me by Sir Hugh Beevor, and printed in Grigor's *Eastern Arboretum*, p. 360.

"Being enabled from old memoranda of undoubted authority, and from information received several years ago from different persons, who remembered or who assisted in the work, to give you, perhaps, an unusually accurate account of the produce of a piece of land measuring eight acres, planted with acorns in the year 1729, I take the liberty of so doing, and of requesting your insertion of it in your paper whenever you may have the best opportunity. The piece was under the plough at that time, cold and unprofitable, from the practice of underdraining not being then introduced; at Michaelmas 1729 it was sown with wheat, and acorns dibbled in; when reaped, the stubble was left very long, which is supposed to have caused the plants to run up very straight.

"Besides a great many used on the ground, from 1729 to 1763, plants were drawn out and sold to the amount of	£100	0	0
In the year 1764 by 1500 poles sold . . .	50	0	0
,, 1765 by 1374 ,, . . .	50	0	0
,, 1767 by 468 ,, . . .	30	0	0
,, 1770 by 501 ,, . . .	39	18	0
,, 1771 by 440 ,, . . .	21	0	0
,, 1777 by 280 ,, . . .	21	0	0
,, 1781 by 150 ,, . . .	80	0	0
,, 1793 by 101 ,, . . .	21	0	0
,, 1794 by 150 ,, . . .	105	0	0
,, 1797 by 30 trees sold . .	20	0	0
,, 1799 by 100 ,, . . .	60	0	0
From the year 1800 to 1810 by 307 trees sold .	389	12	0
,, 1811 to the year 1821 by 94 ,, . .	219	0	0
,, 1821 ,, 1833 by 36 ,, . .	108	0	0
	£1314	10	0
The underwood never came to perfection, but was stubbed up in the year 1767, and the feed of the ground let for 10s. an acre for thirty years .	120	0	0
Value of the feed at the same price to the present time	144	0	0
There are now 320 trees standing, worth if now felled	1200	0	0
	£2778	10	0

"The expenses of felling cannot be now correctly ascertained, but the topwood is not included in the above account of receipts, nor a great many trees which have been used on the premises from the year 1763 to the present time, and at a moderate estimate must have much more than paid for the expenses of the labour.—Thos. Howes, Morningthorpe, April 22nd, 1834."[1]

The Earl of Darnley showed me an oak in "Mount Meadow," near Cobham, planted by Lady Elizabeth Brownlow, who was born in the year 1800, which therefore could not be much over 100 years old. It has a straight clean bole measuring about 40 feet by 12 feet 10 inches, and a small spreading top.

The following extract from a letter of Robert Marsham to Gilbert White is worth quoting, though I could not identify the tree when I visited the place recently.

"*Stratton*, 24*th July* 1790.—I early began planting, and an oake which I planted in 1720 is at one foot from the earth 12 feet 6 inches round, and at 14 feet (the half of the timber length) is 8 feet 2 inches. So measuring the bark as timber gives 116½ feet buyer's measure. Perhaps you never heard of a larger oak, and the planter living. I flatter myself that I increased the growth by washing the stem, and digging a circle as far as I supposed the roots to extend, and spreading sawdust, etc., as related in the *Phil. Trans.* vol. lxvii. p. 12."

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[1] Sir Hugh Beevor in 1902 measured eleven of the oaks remaining in this grove, which was nearly all felled in 1885, and found that they averaged 80 to 90 feet high by 8 feet 2 inches in girth at 6 feet, the cubic contents being about 145 feet each.

Blenkam[1] mentions a remarkable instance of rapid growth:—"Three thriving oaks, growing on a hard gravelly and poor soil, were felled in Nottinghamshire, which on an average girthed 15 feet at three feet from the ground, and each tree contained about 430 cubic feet. The trees were planted in 1692 or 1693, and were about 149 years old when felled. They were perfectly sound and yearly increasing in size."

In a paper by Mr. Clayton[2] a photograph is given of a section across the butt of an oak felled at Ravenfield Park between Doncaster and Sheffield in 1885, which had a butt 36 feet long without a branch, and an average diameter of 5 feet, and which showed only 212 annual rings on a radius of 27¾ inches. If the actual age of this tree was only 212 years, its growth must have been unusually rapid, and a comparison of this with the section of the oak from Wistman's Wood (cf. p. 326) shows how remarkably the growth of trees depends on their situation.

As an illustration of the possible value of a hardwood plantation about forty acres in area in the Sherwood Forest district, I am able to give the following particulars, for which Mr. Doig, forester to Earl Manvers is my authority. In White's *History of Sherwood Forest* the land in question is called "Robert Fitzorth's land." It now goes by the name of Osland. It had been in cultivation previous to 1730, about which time it was planted, or perhaps sown, with beech, oak, ash, chestnut, larch, and spruce. The conifers had mostly been cut previous to 1846, before which time there are no records of the value of the thinnings taken from it. Since then the following have been cut or blown down:—

	Number.	Cubic Contents.	Value.		
Oak	1801	38,735	£3,732	2	9
Oak poles	1628	8,696	371	5	1
Beech	2054	74,213	3,756	0	8
Ash, elm, etc.	63	2,215	123	2	5
Chestnut	43	1,289	102	4	4
Larch and spruce	117	660	26	9	1
	5706	125,808	£8,111	4	4
Standing in 1903:—					
Oak	182	18,200	1,820	0	0
Beech	701	63,090	3,154	10	0
Chestnut	14	1,336	88	10	0
Larch	5	400	23	6	8
Total	6608	208,834	£13,197	11	0

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[1] *British Timber Trees*, 42 (1862).

[2] *Trans. Bot. Soc. Edin.* xxii. 396.

This shows an average number of trees per acre (omitting the oak poles) of about 125, and a value of £320 per acre.

Perhaps the greatest increase of girth on record in the oak is cited by Gadeau de Kerville[1] of three oaks which were felled at Neauphe-sur-Dives (Orne) in Normandy in 1894. Their exact age was not possible to decide, as they were already trimmed and barked and part of the sapwood taken off, but the rings counted by M. de Kerville were 115 to 120, and the girths 6.16, 4.98, and 4.28 metres respectively. He thought that they might be from 150 to 200 years at most, and this would make the average annual increase of the largest, on the section measured, over 5 centimetres per annum.

REMARKABLE TREES

The mass of information on the oak which exists in English literature, is so great, so scattered, and often so impossible to verify, that I have had great difficulty in making a selection of what is really valuable and authentic, and have preferred rather to speak of trees and woods that we have seen ourselves, and to quote from the letters of living correspondents, than to repeat what has been written by Evelyn, Hunter, Strutt, Selby, Loudon, and other writers, whose works can always be consulted by those desirous of more detailed particulars than our space will allow.

Some of the most wonderful oaks of England, which we have seen and now figure, must be described more particularly, and among these I think the oaks of Powis Castle come first. Robert Marsham, in a letter communicated by Sir T. Beevor to the *Bath and West of England Societies' Transactions*, i. 78 (1783), says:—"The handsomest oak I ever saw was in the Earl of Powis' noble park by Ludlow in 1757, though it was but 16 feet 3 inches. But it ran straight and clear of arms, I believe, near full 60 feet, and had a large and fine head."

In April 1904 the Earl of Powis showed me some trees growing in his ancient park at Powis Castle, near Welshpool, Montgomeryshire, which I believe to be actually the champion oaks of Great Britain at the present time. They grow on a Silurian formation at about 300 to 400 feet elevation, with an east aspect, and are, as far as one can judge, perfectly sound in the butt, though one of them lost several branches during the dry seasons between 1893 and 1903, and another has a large decayed limb which, if not taken off, may cause the butt to decay.

The measurements which I give were made most carefully by Mr. W. F. Addie, agent for the Powis estates, who used a long ladder and a man to climb nearly all over them and take the length and girth of the principal branches down to 6 inches quarter-girth. I checked the height and girth of the trunks myself as carefully as possible, and believe that the following is a very accurate estimate.

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[1] *Les vieux arbres de la Normandie*, iii. 373 (1895).

	Girth at Ground.		Height of Bole.	Girth at 4 Feet 6 inches.		Height of Tree.	Cubic Contents.
	Feet.	Inches.	Feet.	Feet.	Inches.	Feet.	Feet.
No. 1. The Champion Tree, by middle gate (Plate 82)[1]	31	7	25	23	6	105	2026
No. 2. Near the Park Plain (Plate 83)[1] The girth of this tree at the top of the trunk, where the tall straight branches begin is 38 feet 3 inches.	40	0	12	29	7	95	1925
No. 3. By Pochfield gate (Plate 84)[2]	32		20	22	6	95	1617
No. 4. In Gwen Morgan Wood	30		31	19	4	93	1432

Of the extraordinary size to which oaks have attained in this district we have a record which is without parallel in this or any country. My attention was called to it by the Earl of Powis, who, knowing the locality, believes it to be true. It is taken from a work called *Collections Relating to Montgomeryshire*, xiii. 424-425 (1880), published by the Powysland Club at Welshpool, and runs as follows :—

"In 1793 and 1796 a large fall of oak timber took place at Vaynor park in the parish of Berriew, when some trees of enormous dimensions were cut down. Major Corbett Winder has kindly favoured us with a copy of the following memorandum of the particulars of the contents of some of the largest trees :—

"Dimensions of twenty-six of the largest oaks cut down in Vaynor Park in 1793 and 1796.

No. of Tree.	Feet.	No. of Tree.	Feet.	No. of Tree.	Feet.
1.	1127	10.	1523	19.	1516
2.	1121	11.	1859	20.	1428
3.	2501	12.	1328	21.	1298
4.	2202	13.	1808	22.	1077
5.	1713	14.	1793	23.	1161
6.	1106	15.	1289	24.	1018
7.	1453	16.	1101	25.	1170
8.	1953	17.	1467	26.	1322
9.	1192	18.	1246		

Total : 37,772 cubic feet, averaging 1452½ cubic feet per tree."

The counties of Hereford, Worcester, Shropshire, and Stafford have produced and perhaps still contain the largest oaks in England, next to those I have just mentioned, but the long years of agricultural depression which have impoverished so many of the squires of England, have caused the felling of many of the finest. Among these the most celebrated was the Hereford Monarch which grew at Tyberton, near the house of Chandos Lee Warner, Esq., to whom I am indebted for two copies of a print taken from drawings which were made by G. L. Lewis, and published in a scarce work called *Portraits of British Forest Trees.*[3] One of these shows the tree in summer, the other in winter, and prove it to have been a tree of faultless shape and beauty, if not quite equal in bulk to the Champion Oak at Powis Castle. I visited the site of this tree in 1905, but the stump was no longer visible, and the soil, though a good deep red loam, did not show in the other trees any striking evidence of unusual fertility.

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[1] The photographs from which these plates are reproduced were taken in June 1904 by Mr. R. G. Foster of Burford.

[2] This plate is from a photograph taken in 1906 by Lord Powis.

[3] Vale, Hereford, 1837.

Its measurements, as given me by Messrs. Openshaw of Woofferton Court, to whom I am indebted for many particulars about trees in their district, were as follows :—

Butt . .	30 feet by 55½ inches quarter-girth	923 feet.
Second length .	60 „ „ 26 „ „	
One branch .	18 „ „ 42 „ „	220 „
Other branches more or less damaged by lightning, about .		400 „
		1543 feet.

A record of the tree was sent me by Messrs. Stooke and Sons of Palace Yard, Hereford, as follows :—" *The Hereford Monarch.*—An Oak tree, containing 1200 cubic feet, felled in Tyberton Park, ten miles from Hereford, April 1877. Length of tree, cut off at 18 inches diameter, 88 feet. Length of butt only 29½ feet. Height of tree when growing 130 feet. Circumference at 5 feet from the ground 22 feet 8 inches. Photograph taken of tree as felled, and showing the larger bough as shattered by lightning. Purchased by Messrs. R. and T. Groom and Sons, Wellington, Salop."

Mr. T. E. Groom of Hereford, whose firm bought it, informed me that though the tree would have been worth about £300 before it was struck, it did not actually cost them more than £200. It was felled in consequence of its having been disfigured by a stroke of lightning. Before this it was a perfectly sound tree with over 1500 feet of timber in it. It was still growing and might have become much larger. The butt was quartered and sold to a vat maker who cut it all into thin rims. At the end of the 30 feet of butt were two parallel spires each containing several hundred feet. The larger one was so much broken that it had but little useful timber left in it. The smaller was 60 feet long and about 2 feet in diameter at the top end. This was cut up into railway planking. The tree also made several thousand keys and trenails used on the railway.

Another immense tree was felled in Staffordshire on May 29, 1786, of which Messrs. Openshaw give me the following particulars :—" It grew in the middle of the Grove field on Bath farm, Chillington estate, and measured as follows :—

Butt, 30 feet by 60 inches = 750 feet at 5s. . . .	£187	10	0
Limbs (22), 560 at 1s. 8d.	46	13	4
Thirteen cords of wood at 10s. 6d. . . .	7	7	0
The root	2	10	0
2½ tons bark	8	8	0
	£252	8	4

"No branches under 9 inches quarter-girth were included in the above. Twelve men worked twelve hours each in felling this tree."

One of the tallest oaks which I have ever measured in England is a comparatively young tree in perfect health and vigour, which, though not shut in by other trees, appears to be still growing, and may even attain a greater height. It stands on the edge of a plantation at the bottom of a steep slope facing north-east in Whitfield Park, Herefordshire, the seat of Capt. Percy Clive, who showed it me in 1906. A careful measurement from both sides made it 130 feet high, or perhaps a little more, by 11 feet 10 inches in girth, with a straight bole of 55 feet free from branches, though two or three small ones had been cut off four years ago. For symmetry and height combined I have not seen its equal in England, and the photograph of it taken by Mr. Foster, though under the circumstances a very good one, fails to give a correct idea of its great height (Plate 85). The soil is old red sandstone, and the tree is of the sessile type.

At Foxley, near Hereford, the seat of the Rev. G. H. Davenport, are many fine oaks, all of which, so far as I saw, are sessile. The best is about 104 feet high by 20 feet girth, with a bole of 20 feet. In the Nash Wood there is a superb lot of young oaks with the tallest and cleanest stems in proportion to their thickness I have seen in England. They may average 90 feet high, and one which I measured was clean and straight to 62 feet and only 3 feet 4 inches in girth. Mr. Davenport believes them to be sixty to seventy years old, and if well taken care of they should in a hundred years be some of the finest of their type in England.

The largest oaks now standing in Herefordshire that I know of are at Holm Lacy, one of which, a short-boled spreading tree now much decayed, was in 1905 75 feet by 30 feet 2 inches, and 125 yards in circumference of the branches. The other, 90 to 95 feet high, with a bole 25 feet by 23 feet 9 inches, is vigorous and healthy, though perhaps not quite sound.

In Lord Leigh's park at Stoneleigh Abbey, Warwickshire, are many fine old oaks, relics of the Forest of Arden, which grow on a red sandstone soil, and are in many cases long past their prime. The largest stands near the Abbey, and is 28 feet 3 inches in girth; though the top is much broken and decayed, the butt seems sound. Another, just outside the Tantarra Lodge, is a vigorous tree of later date, and measures 22 feet 10 inches in girth, with a fine spreading crown; a third, near the river, is 27 feet 5 inches in girth. The most interesting, however—of which I hope to give an illustration later—is Shakespeare's Oak, so called from the tradition that Shakespeare used to sit and write under it. It grows on the top of a low sandstone cliff, over which at least half the thickness of its trunk projects, and is supported entirely by the roots on the other side to which it leans; it measures no less than 25 feet in girth, and though deeply cleft on one side and hollow, has vigorous branches.

The oak grove at Kyre Park, Worcestershire, the property of Mrs. Baldwyn Childe, was first noticed by the Woolhope Club, who visited it in 1893, and described later by Sir Hugh Beevor, who published a short account of it.[1] I had the pleasure of visiting this wonderful grove in March 1904, when some photographs were taken (Plates 86 and 87), which give a good idea of the remarkable size and height of the trees. The soil is a good deep loam on the red sandstone formation. The grove is unfenced and has been open to cattle for many years, and there is no visible evidence of the trees having been drawn up by beech. The majority of them are of the sessile variety, though some are pedunculate oaks, as proved by specimens kindly sent me by Mrs. Baldwyn Childe and by the observation of her very obliging agent, Mr. J. W. Openshaw, who found six trees of the pedunculate to about twenty-four of the sessile form. Sir Hugh Beevor speaks of them as sessile, and at the time I was there it was difficult to distinguish one from the other. As to their age, Mr. Openshaw writes that he could not count the rings because they were so minute, but from the evidence of Habingdon's *History of Worcestershire*, written in the time of Queen Elizabeth, they must be very old. Habingdon says:—"The Parcke of Cure Wyard is not to be shutt up in silence, for it is adorned with so many tall and mightie oakes as scarce any ground in England within that quantity of akers can showe so many." Most of these trees do not show decay in their tops like so many of our great park oaks, and may thrive for centuries to come.

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[1] *Trans. of the English Arboricultural Society*, v. 473.

Sir Hugh Beevor's measurements of their height agree very fairly with my own, but exact measurements of the heights of such trees are difficult to obtain, and they are not so remarkable for their girth as for the way in which they run up with clean stems to a great height. The two tallest are certainly over 130 feet by my own measurements in 1907. Sir Hugh Beevor gives 78 and 79 feet as the first length of two, and one which was blown down in 1897 was 82 feet to the first limb, though only 16 inches in quarter-girth, and with no measurable tops. These trees show very few burrs, but some have large buttresses at the base.[1] The largest, according to Mr. Openshaw, has a stem 83 feet long by 17 feet 8 inches in girth at 5 feet, and contains 1031 cubic feet of timber. Fourteen of them contain over 600 feet, and the smallest tree in the grove has 97 feet, which is considered a big oak in many districts. The tree I have figured (Plate 86), with Kyre House in the background, is on the outside of the grove, and of different type from most of them. It is the third largest tree in contents, having 694 cubic feet in the butt and 150 cubic feet in the tops. I made it 115 feet high by 18 feet 6 inches at 5 feet, and it looks vigorous and is growing fast. The other tree figured (Plate 87) is 85 feet to the first limb, 13 feet 6 inches in girth at 5 feet, and contains 604 feet in the butt, and 112 in the tops. The measurements given below, taken by Mr. Openshaw, may be thoroughly relied on. They were taken in the usual way by strap, and good allowance made for taper. The heights were taken with the help of a long pole; and both Mr. Openshaw and his father, who has probably as much experience in measuring big oaks for sale as anyone in England, are confident that the grove contains more than they have estimated, though no doubt a quantity of the timber would be broken in falling if cut. Of this, however, there is not the least risk in the lifetime of the present owner, who is much interested in, and very proud of her trees.

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[1] One of these measures no less than 44 feet round the base, and at five feet from the ground is 20 feet in girth.

"*Kyre Park.*—Measure of oak trees in Woodpatch grove made by John W. Openshaw, November 1904. The tape girths are over bark taken at 5 feet. The quarter-girth is the middle of first length taken under bark. Eleven trees removed (1883, 1887, 1897) contained 2990 feet, average 272 feet. Ninety-seven trees now standing contain 38,365 feet, growing on 5 acres, 2 roods, 19 poles of land; an average of 395⅝ feet per tree. A hundred and eight trees contained 41,365 cubic feet, an average of 383 feet per tree. There remain distinct traces of sixty and indistinct traces of ten trees having been removed, including the eleven referred to above."

Number (in Mr. Openshaw's Table).	Girth at 5 Feet High.		Length of Stem.	Quarter-Girth.	Contents.		Total Content of Tree.	Remarks.
					Trunk.	Tops.		
No.	Feet.	Inches.	Feet.	Inches.	Feet.	Feet.	Feet.	
10	21	6	65	54	644	129	773	Very large spurs at base.
13	15	0	61	40	538	83	621	
16	17	6	49	45	447	156	603	
23	19	6	72	30	450	200	650	Blown down, 1904.
25	17	0	28	45	393	258	651	Forks.
57	18	0	73	45	421	249	670	Forks.
60	13	6	85	32	604	112	716	Tree in group.
62	17	5	60	40	666	224	890	
63	19	6	45	46	447	184	631	
72	15	9	88	42	573	60	633	
78	15	2	62	36	558	145	703	
79	18	9	75	50	694	150	844	Single tree in photo., facing Kyre House.
81	16	6	69	41	532	160	692	Leans, large top.
82	14	0	82	35	522	110	632	
91	17	8	83	47	851	180	1031	Ivy growing, largest tree.
97	14	5	95	34	633	100	733	By holly tree.
							11,473	

There is an oak of remarkable size in another part of the Kyre estate called the Hannings, growing on high ground exposed to the north, in a rough pasture overgrown with trees, which no doubt have drawn it up in youth. It is 113 feet in total height, with a trunk nearly straight to about 90 feet high, where the head begins, and 15 feet 10 inches in girth. Mr. Openshaw and I estimated its contents as follows:—

1st length . . . 18 feet by 48 inches = 288 feet.
2nd ,, . . . 20 ,, 40 ,, = 222 ,,
3rd ,, . . . 50 ,, 24 ,, = 200 ,,
710 feet.

£100 was refused for this tree a few years ago.

There is also in the deer park a circle with a diameter of fifty yards formed by ten (formerly twelve) oaks of great age and very spreading in habit, and a very ancient oak near by, called the Gibbet Oak, on which tradition says that criminals were formerly hung in chains.

Of the difficulty and risk of removing some of these immense trees when steam traction engines were not in use by timber merchants, Mr. Openshaw gave me an excellent instance which he actually saw himself. A very large oak was felled in a field near Woofferton and sold to a naval timber buyer at Exeter. It was so long and heavy that two of the largest timber carriages were fastened together, and 28 horses brought to get it away. In rolling it up on to the carriage one of the chains got round a horse's leg, but they dared not stop to clear it, and the horse was killed. Mr. Openshaw saw the carriage coming down the road with the log on it, and, believing that it could not pass through the turnpike gate, warned the woman who kept it, to get out of the house, as if the log touched it the house would certainly come down. The man in charge of the team, however, ran on in front and steered the leaders so accurately through the gate that, with an inch to spare, it got past in safety.

It seems probable that many of the great oaks in England which are now decayed, owe their lives to the cost and risk of converting and removing them in the days when there were no railways, and good roads were scarce or absent.

The Nunupton Oak.—The remains of a very large fallen oak, not, however, so big as the one at Croft Castle, is described in the *Transactions of the Woolhope Naturalists' Field Club*, 1870, p. 307. It had long been hollow, and was large enough to contain forty-two sheep at once. It was alive and covered with leaves up till about 1851, when it was set on fire by accident, and was felled soon afterwards, with what object I do not know. In 1870 it was 60 feet long and 26 feet 8 inches in girth, and was still lying in much the same condition when I visited it in 1904.

According to the late Mr. Edwin Lees, whose knowledge of the botany of Worcestershire was very accurate, and whose sketches of old trees, some of which I have, through the kindness of his widow, been allowed to copy, the finest old oak in the county known to him in 1867 stood in a field near the Severn, below Holt, and was known as the Boar Stag Oak. It measured about 34 feet in girth at 3 feet from the base, and might be roughly calculated at 800 years old.

Other remarkable oaks in Worcestershire were described and figured by W. G. Smith, in the *Gardeners' Chronicle*, 1873, p. 1497. They grew in the Lug Meadows, near Moreton, and were known as Adam and Eve. When the Shrewsbury and Hereford Railway was made, Eve, which measured 25 feet in girth, and was quite hollow, was converted by the navvies into a residence: the top was thatched in, a brick fireplace built, and a door fitted, and for months after the line was opened this tree was the only residence of the stationmaster, and was afterwards converted into a lamp-room and so used for fourteen years.

The finest oaks that I know of in Somersetshire are at Nettlecombe Court, the seat of Sir Walter Trevelyan, Bart. When staying at Dunster Castle, in March 1904, Mr. Luttrell was good enough to give me an opportunity of seeing them. He told me that at a previous time, which, from the information received from the agents for the property, I gather to have been about 1847, but Mr. Luttrell thinks it was earlier, £40,000 was offered for about forty acres of oak timber on this property; and an old man at Nettlecombe said that the tools were actually brought to the place ready to fell them, when the owner changed his mind and they were allowed to stand. A considerable part of these oaks have been since felled, but a magnificent grove still remains on the slopes of a combe, at an elevation of five to six hundred feet on the south-west side of Nettlecombe Park, facing to the north and east, and on a soil locally called "shiletty," which is a reddish rocky formation, overlaid by a thin layer of rubbly stone, probably old red sandstone, which would appear too thin and dry to produce big oak timber. The age of these trees, so far as I could judge by counting the rings of one which had been blown down, is not more than 200 to 250 years, but some may possibly be much older.[1] The majority are very clean and free from limbs to from 40 to 60 feet up, and average 10 to 12 feet in girth. One, about 210 years old and over 100 feet long, was 3 feet in diameter at the butt, and had fifty annual rings in a radius of 9 inches near the heart, but outside of this the growth had been much slower. I had not time to measure them carefully, or estimate the number now standing on an acre; but two of the finest trees on the steep banks of the combe were 116 by 14 feet, with a bole 65 feet long; another was 116 by 16 feet, with a bole of 50 feet by 36 inches quarter-girth. The thickest trees, which I did not measure, are on the outside of the grove. Assuming the price of £1000 per acre to have been based on 4s. per foot for the butts, which for trees of this size and character would, sixty years ago, have been about the value, and the trees to have averaged 200 cubic feet, there would have been perhaps forty trees to the acre, averaging £25 each, and though the cubic contents do not come up to what we are told is produced in some of the picked areas of oak forest in France and Germany, I have never heard of an actual sale of any timber in England at so high a price.

At Hazlegrove, Somersetshire, the property of the Rev. A. St. John Mildmay, is a remarkably fine oak, reported to be the largest in the county. It is about 75 feet high by 29 feet 9 inches at 5 feet from the ground, and at ground level spreads out to no less than about 18 yards in circumference. Though it seems sound, yet it has a rent on the north-east side, as though struck by lightning, and many of the largest limbs have been broken by wind, and are mended with lead. A drawing of it, made in 1833 when it seems to have been in full vigour, is in Hazlegrove House.

In Melbury Park, Dorsetshire, the seat of the Earl of Ilchester, there is an extraordinary oak, known as Billy Wilkin's Oak (Plate 88), which swells into an immense burry trunk, 38 feet in girth at the ground, and 35 feet at 5 feet up. Above this it falls away a good deal, and is only about 50 feet high. Like all the trees I have seen of this type, of which perhaps it is the largest in England, it is of the pedunculate variety, and bears acorns abundantly.

At Longleat, Wilts, which has a most beautifully timbered park, and is one of the finest places in England, there is an extremely fine tall oak growing in the grove of limes which I shall describe later, in a position which makes it difficult to photograph. This tree measures about 100 feet high by 23 feet in girth, and has a fine clean bole of 40 feet. It contains, according to Mr. A. C. Forbes's estimate, about 950 feet of timber.

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[1] The Rev. Mr. Hancock, who is a connection of the Trevelyans of Nettlecombe, says that he has always heard that they were planted about 1600, when part of the existing house was built.

The finest oak I have seen in Devonshire is in the park of the Hon. Mark Rolle at Bicton, a place long celebrated for its arboretum and for its avenue of Araucarias, which I have elsewhere described. It measures about 78 feet high by 24 feet 8 inches girth at 3 feet, and has a spread of branches of 103 feet in diameter. There are some fine but not extraordinary oaks at Powderham Castle and at Poltimore in the same county.

Near Mottisfont Abbey, Hants, there is a very thick but short pollard oak on the banks of the Test, of which a photograph, by Mr. J. Bailey, Southampton, has been kindly sent me by Mrs. Meinertzhagen, who long resided at Mottisfont. It measures 32 feet in girth and spreads considerably, and, though evidently of very great age, is full of healthy foliage. It must have been frequently flooded, as it stands close to the river.

Near Bramley, Hants, by the road leading to "The Vine," is an oak, which Henry measured in 1905, 100 feet by 22 feet, and which seems quite sound. There are, so far as I know, no oaks now living in the New Forest which are remarkable for their size as compared with the trees I have mentioned.

Of the historical parks of England I know none which contains so many fine oaks as Bagot's Park, near Rugeley, Staffordshire. This must be one of the oldest parks in England, for though Lord Bagot cannot tell me the exact date of its enclosure, he states that it belonged to his family long before 1367, and that in the "Peregrinations of Dr. Boarde, *temp.* Henry VIII.," printed at the end of Hearne's *Benedictus Abba*, p. 795, "Baggotte's Park" is mentioned in the list of Staffordshire parks. It is generally said to contain 1500 acres within the pale, but varies from time to time, as land has been added in some places and taken out in others for planting, to be again restored when the woods are grown.

This practice seems to be well worthy of more general adoption, for no one who is acquainted with the condition of the trees in many of our oldest parks can have failed to notice, that they are as a rule going back; and as trees cannot be successfully raised to a great height if deer are not excluded—unless enclosures of considerable size are made about once in a generation, in which trees can be properly drawn up to a sufficient height, before they are thinned and the deer admitted—the time must come, and in some cases already has come, when nothing but wrecks are left, and the singly planted trees, though protected by iron or wooden guards at great cost, are a mere mockery of their predecessors.

The soil in Bagot's Park is poor and cold, being a moist gravelly loam upon a clay or marl bottom, and Lord Bagot says it is not worth 10s. per acre at the present time. It affords, however, an excellent proof of the fact that land which is not valuable from an agricultural point of view, may often be of great value for planting. The woods extend over many hundred acres and consist almost wholly of oak, mostly, I believe, of the pedunculate variety. Many of the trees are of great age, being mentioned by Dr. Plot in 1686 as full-grown timber.

I visited it in March 1904, and, though the weather was dull, Mr. Foster was able to secure some excellent photographs, of which I reproduce the following:—

Plate 89 represents the Beggar's Oak, which has been well figured by Strutt in his plate No. 2, and though eighty years have elapsed since that picture was taken, a comparison with my plate shows that very little change has taken place in the tree—thanks to the care with which it has been treated by successive owners, who have worthily kept up the spirit described by Strutt in his account of this tree. It now measures, as nearly as I could estimate, 62 feet high, with a bole of about 33 feet long, and a girth of 24 feet. The roots measure 25 paces round, and the branches cover an area of 114 paces round (according to Lord Bagot's measurement 7850 square feet). It is one of the finest and best-preserved oaks of its type that I know, for though the Major Oak in Sherwood Forest (Plate 95) is bigger, it is not nearly so sound; and the Bourton Oak (Plate 93), which is taller and in better condition, is not so large in girth or so spreading at the base.

Another very fine tree in this park is the Squitch Bank Oak, also figured by Strutt (Plate 34), who gives its measurements as follows:—height, 61 feet; girth, 21 feet 9 inches; contents, 1012 feet. When I saw it in 1905 its top was dead, and the butt seemed to be decaying at the base internally. I measured it as about 60 feet by 24 feet 10 inches, so that it has increased three feet in girth in eighty years. The Beggar's Oak, in the same time, has increased rather more, but in measuring the girth of such trees as this a few inches higher or lower will often make a great difference, and therefore these rates of increase cannot be considered exact.

Other great trees in this park mentioned by Strutt were the Rakeswood Oak, the Long Coppice Oak, and the twisted oak on the Squitch Bank, which, though I did not see them, still survive. In the Horsepool grove are a number of younger but very tall and straight trees, which have been grown close together, and which Lord Bagot's old woodman, W. Jackson (now dead), said he "could remember so thick that you could hardly swing an axe amongst them." Of these, one, which was called Lord Bagot's Walking-Stick, is the straightest and cleanest oak I ever saw in England, though recently struck by lightning; another was 95 feet by 8 feet 6 inches, with a clean stem 65 feet high. On the other side of the park, at the west end of the grove called the Cliffs, are a number of splendid trees of great size. Two of them, standing near each other, are figured in Plate 90. Of these, the one in the foreground measures about 112 feet by 16 feet 8 inches, with a bole 35 feet high and four great erect limbs. The other, about the same height and a foot less in girth, has a clean bole 45 feet high. One hundred pounds was offered and refused for it. In the same grove, farther east, is an oak with a bole about 40 feet by 15 feet 3 inches, twisted from right to left, and another called the King Oak, which, though now partly hollow, has been perhaps the finest timber oak in the park (Plate 91). It is now about 100 feet high, but has been taller, as the topmost branches are dead, with a straight clean bole 21 feet 3 inches in girth, and must have contained over 1000 feet of timber. It is stated[1] that in 1812 £200 was offered for the first length of this tree, estimated at 12s. per foot, and £93 for the remainder, including the bark, estimated at £14 per ton. Near it is a tree of great height, leaning at an angle of about one in four to one side, though quite firm in the ground; and it seemed to me that all the trees in this grove owed their great height and clean stems to their having been drawn up by beech trees, many of which are now dead or dying. Close to the Park Lodge are three very curious and picturesque old trees, one of which is called the Venison Oak, because King John is supposed to have dined under it; another, which we christened the Beer-barrel, is an immense burry shell 10 or 12 feet high and 28 feet round, with hardly any branches; a third we called Gouty Toes, because of a huge swollen root, like a gouty foot, on one side of it.

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[1] *Gard. Chron.* xvi. 230 (1881).

Dr. Plot, in his *Natural History of Staffordshire*, p. 213, after speaking of different species of trees growing together, among which were an oak and an ash near Chartley, hollies and oaks at Bagot's Park, and an oak and thorn at Drayton Basset, goes on to speak of trees "that grow so conjoynd that they seem (after the manner of some sort of animals) to prey upon one another," and says: "But the most signal example of this kind is the large fair birch, about the bigness of one's thigh, that grows on the bole of an oak in the lane leading south from Adbaston Church, which has sent down its roots in six branches perpendicularly through the whole length of its trunk and fastened them in the ground, which might be seen in a hole cut in the bottom of the oak; having eaten out the bowells of the old tree (as all the rest will doe) that first gave it life and then support. All which are occasioned, no doubt, by the seeds of those trees dropt by birds in the mould on the boles of the others that lyes commonly there, and is made of the annual rottings of their own leaves."

He goes on to speak of another great oak, "lying near the Lodge house in Ellen Hall Park, of so vast a bulk that my man upon a horse of 15 hands high, standing on one side of it, and I also on horseback on the other could see no part of each other"; and also of an oak that "was felled about twenty years since in Wrottesley Park which, as the worthy Sir Walter Wrottesley (a man far from vanity of imposition) seriously told me, was 15 yards in girth."—"How much less in bigness and number of tuns the oak might be that grew in the New Park at Dudley, and made the table now lying in the old hall at Dudley Castle, is not remembered, but certainly it must be a tree of prodigious height and magnitude out of which a table all of one plank could be cut, 25 yards 3 inches long and wanting but 2 inches of a yard in breadth for the whole length, from which they were forced (it being so much too long for the hall at Dudley) to cut off 7 yards 9 inches, which is the table in the hall at Corbins Hall hard by, the ancient seat of the Corbins."

In the park at Merevale Hall, Warwickshire, the seat of W. F. S. Dugdale, Esq., are a quantity of very fine and tall oaks, which rival those at Bagot's Park, and are, according to Sir H. Maxwell, of the sessile variety, though when I saw them they were not in leaf. They stand at a considerable elevation, on a dry and seemingly rather shallow red sandstone. Many of them are 100 feet and more in height, with clean trunks of 40 to 60 feet long.

The best that I could find measured as follows:—112 feet by 13 feet, with a straight bole 65 feet long; 107 feet by 15 feet, with a clean bole of 70 feet, and probably containing about 600 feet of timber; 107 feet by 17 feet 3 inches, with a bole 48 feet long, and about the same cubic contents as the last; 114 feet by 15½ feet, bole about 60. This last is, I believe, the same tree which Mr. Dugdale had measured some years ago, when it was thought to be 133 feet high; but I do not think it can be nearly so much, the sloping ground on which it stands making a base line difficult to get. He tells me that these trees are believed to have been planted by the monks who lived at Merevale Abbey at the foot of the hill, which would make them at least 370 years old, and that most of them have now passed their best. The timber being very straight in the grain is largely used for cleaving spokes.

Chirk Castle in Denbighshire, the seat of R. Myddleton, Esq., and one of the most ancient inhabited castles in England, is in a park full of oaks, most of which I believe to be of the sessile variety. They are not of great age, having been planted, as Mr. Parker, agent for the property, told me, after the Commonwealth, but are remarkable on account of their uniformly straight boles 30 to 60 feet high. They grow on millstone-grit, where the rock comes very near the surface, on land where the pedunculate variety would not, I think, make nearly such fine trees. I only measured two, one just below the castle which was 100 feet by 11 feet 8 inches, with a straight clean bole of 60 feet; another, probably of greater age, about 90 feet by 18 feet 2 inches, was beginning to decay at the base. A curious growth is seen on an oak in this drive, a branch having grown out of one stem into another, somewhat in the same style as the beech in Plate 4 of this work.

The trees in the Great Park of Windsor have been described by many writers, and especially by the late Mr. William Menzies in a rare folio published by Longmans in 1864,[1] which gives photographs of some of the finest trees, these being, so far as I know, the first large photographic plates of trees published, and, considering the imperfect development of the art forty years ago, wonderfully good.

They show Queen Victoria's Favourite Oak, which was chosen by her late Majesty shortly after her accession, and which stands with the three other royal trees between High Standing Hill and New Lodge. This is a very well shaped tree of fair size, 70 feet high and 11 feet in girth when Menzies measured it in 1864. Now, as I am informed by Mr. Simmonds, it has increased only 9 inches in girth. Queen Anne's Oak, a very handsome tree in shape, but past its prime, though supposed to be only 400 years old, measured 60 feet in height by 15 feet 3 inches in girth. Queen Charlotte's Oak, a tree of no special beauty, was 65 feet high by 17 feet 3 inches in girth. The great Pollard Oak at Forest Gate, known as William the Conqueror's Oak, and figured in the Supplement to *Gardeners' Chronicle*, 31st October 1874, supposed by Menzies to be 800 years old, though about 37 feet in girth, and the largest in the forest, is now a wreck; but there are near the Prince Consort's chapel, and in the Cowpond grove, many beautiful tall and straight-grown oaks, one of which, growing near the culvert of the pond, measured by me in March 1904, was from 114 to 118 feet high and 10 feet

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[1] *History of Windsor Great Park and Windsor Forest.*

10 inches in girth. For this tree Mr. Simmons told me, £100 was offered to make the keel of a ship forty or fifty years ago. It should live for many years, and may perhaps become the finest timber oak in Windsor Forest.

Mr. Menzies gives[1] an excellent explanation of the old custom of pollarding oaks and beeches, which has produced the picturesque veterans which are so common in most of our really old parks. For the support of the deer in winter it was customary to lop off the boughs of the oak and beech. The law required that no bough should be cut larger than a buck could turn over with its horns, and after they had been stripped by the deer these branches became the perquisite of the keepers, under the name of "fireboote," or "houseboote." Any timber fit for the navy could not be cut without the sign manual of the King, a rule yet extant; but in times of civil war, and in royal forests which were granted to favourites in the times of the Stuarts, the keepers often cut and sold as timber or firewood a great deal more than the deer needed; and notwithstanding that these matters were investigated by James I. with his national and personal thriftiness, and that the surveyors whom he employed were spoken of by the country people as "shroade and terrible men,"[2] these abuses increased to such a point that the growing scarcity of naval timber was a common complaint for centuries.

There is no doubt that browse or lop, being the natural winter food of deer in hard weather, is more suitable for them than beans and maize, which is now given in so many places probably to save trouble. I find in my own park that ash and elm are the favourites, and beech the next best lop for deer, and only give hay when the ground is frozen or covered with snow; but many parks are so overstocked with deer and with cattle in summer that in February and March the former must have some extra food, or a heavy death-rate follows.

Gloucestershire is not famous for fine oaks, though the Boddington Oak, near Tewkesbury, now gone, must have been an exceptionally large tree. The Newland Oak, near Coleford, is an immense pollard, with a short burry trunk no less than 43 feet in girth. An excellent photograph of it has been published as a postcard by Mr. J. W. Porter of Coleford. There are some fine ones in the Winchcombe Valley, near Sudeley Castle, one of which is 25½ feet in girth; but in the Vale of Gloucester elms are commoner than oaks, and I know none of special note, though Mr. J. R. Yorke tells me of a large tree still standing near Forthampton Court.

The largest I have seen are in Witcombe Park, the seat of W. H. Hicks-Beach, Esq., a small but picturesque park lying under the steep Birdlip Hill. Here on fertile clay soil, facing north and west, are a number of very fine trees, which, judging from the rings counted on one of the largest which has recently been felled, are not so old as they appear to be. This tree, which measured about 90 feet by 17½ feet, and contained 400 to 500 cubic feet, was only about 210 years old, and beginning to fail in the upper branches, which were dying off. The largest tree, in a very exposed position, has lost some of its biggest limbs, and measures 25 feet in girth at about 5 feet from the ground, and 50 feet round the roots at the base. A very tall, well-shaped, handsome tree, with its bole clean and straight for 30 to 40 feet, stands on high ground in the centre of the park; and at the bottom of the hill near the house is a pollard which seems sound, and is 24½ feet in girth at the smallest part of its trunk.

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[1] *Op. cit.* 7.

[2] Arthur Standish, *The Common Good.*

In a grove near Campden, close to Norton House, which has been lately restored by the Earl of Harrowby, I was shown a remarkably tall and clean oak over 100 feet high with a straight bole clean for 60 feet, but only 7 feet 5 inches in girth.

Near Bourton-on-the-Water, on the east side of the road to Stow, stands a pedunculate oak which, of its type, is almost equal in size to any I have seen, and which is specially remarkable on account of the perfect condition of all its branches, which, as Plate 93 shows, are growing to the very tips, and which spread over an area of 115 paces in circumference, equal to that of the Beggar's Oak. This tree grows in a grass field on the property of Mrs. Butler of Wick Hill.[1] It measures about 85 feet high by 22½ in girth, and has the appearance of having been pollarded at about 12 feet up very early in life. There are some fine tall oaks at Wick Hill, not far off, measuring 85 feet by 14 feet and 80 feet by 13 feet, and there are still some big ones in the cow pastures at Sherborne Park in the same district. But the best of these were felled fifty years ago by the father of the present Lord Sherborne, who has never ceased to lament their loss.

There are many superb oaks in Earl Spencer's park at Althorp, Northants, which were carefully measured by the former forester, Mr. Mitchell, now at Woburn. Lord Spencer's ancestors were evidently great lovers of trees, and followed a practice which is much to be admired. In Althorp Park are several inscribed stones, giving the date of planting and the name of the planter. The earliest of these is in the Heronry, and is dated 1568.

Of the others one reads as follows—	Another has the legend—
This Wood was planted by Robert Lord Spencer In the year of our Lord, 1602-1603	This Wood was planted by Sir William Spencer, Knight of the Bath in the year of our Lord 1624 Up and be doing, and God will prosper

When one sees how small are the trees planted about 300 years ago, when compared with the older trees, one realises the immense time it takes for such oaks to grow. The finest at Althorp is shown on Plate 94. It grows near a farmyard, and is No. 8 in Mitchell's list.[2] It measures about 90 feet in height, and carries a thick straight stem up to about 45 feet high, and girths 19 feet 6 inches at 5 feet. It must contain at least 1000 feet of timber, and is apparently sound, healthy, and growing, with no signs of decay in the top.[3]

There are some very fine oaks in Burleigh Park, Stamford, the seat of the

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[1] In 1906 I saw this tree again, and found that a large fungus had attacked its trunk, and that some of the branches were showing signs of decay at the ends. Steps are being taken to preserve it as far as possible.

[2] A description of some of the finest trees at this place is given in *Trans. Scottish Arb. Soc.* xiii. 83.

[3] Sir Hugh Beevor measured fifteen oaks standing on one acre in a grove planted at Althorp in 1561-1568, and found them from 100 to 115 feet high, with an average girth of 11 feet 8 inches, and the average cubic contents of the first length of 54 feet was 330 feet. In another plantation, made in 1589 on stiffer soil than the last, there were more trees per acre, but their size was less, the average being 90 feet by 9 feet 7 inches.

Marquess of Exeter. The best, known as the King Oak, is 100 feet high by 16 feet 6 inches in girth. At Ashridge the oaks are not so fine as the beeches, but the King Oak in that park is a splendid tree, measuring 98 feet by 21 feet 8 inches.

Sherwood Forest, in Nottinghamshire, contains an immense number of very ancient, picturesque, and curious oaks, many of them now mere wrecks, but preserved with care by Earl Manvers, who is the owner of a large area of the unenclosed part of what was formerly a royal forest. I have seen no other place where so many of the trees are covered with immense burrs, and where they assume such extraordinary shapes, as in that part of Sherwood Forest between Edwinstowe and the Buck gate entrance to Thoresby Park. The soil in this district is mostly a poor-looking sand on which the birch thrives remarkably. About seventy years ago the open forest which up to that time had been grazed by sheep, came into the possession of Lord Manvers. An immense quantity of seedling birch then sprang up, and large quantities of acorns were sown to fill up the vacant spaces caused by the decay of the old oaks, most of which are now stag-headed, and dead at the top.

The finest oak now standing in Sherwood Forest is the Queen or Major Oak (Plate 95). This tree, though hollow, and having its branches partly supported by iron stays, is still healthy and vigorous. It measures about 60 feet in height by 30 feet 5 inches in girth, and the spreading roots are about 18 paces round at the ground. The spread of the branches is 30 yards in diameter. It is about three-quarters of a mile from Edwinstowe, and is not far from another tree known as Simon Foster's Oak, which is about 44 feet high and 25 feet in girth.

At Welbeck, the seat of the Duke of Portland, in the same beautiful and well-wooded district, known as the Dukeries, on heavier soil than that at Thoresby, are a number of magnificent oaks which were described and figured in 1790 in a scarce pamphlet by Major Rooke. Of these I saw the Porter Oaks, so called because they stand opposite each other on each side of a gate in the park. When measured by Rooke about 1779 they were as follows:—No. 1. 98 feet high, 23 feet girth at 6 feet; contents, 840 feet. In October 1903, 25½ feet; the top having been dead for many years it is now much less in height. No. 2. 88 feet high, 20 feet girth at 6 feet; contents, 744 feet. Now it is 23 feet and rapidly decaying.

Another tree, called by Rooke the "Duke's Walking Stick," of which there is a small figure in Loudon, p. 1766, was in 1779, 111 feet 6 inches high, and 70 feet 6 inches to the first branches; at 6 feet it measured 12 feet in girth, and was estimated to contain 440 cubic feet. A very celebrated oak at Welbeck is the Greendale Oak, which has often been figured and described. In my copy of Strutt there is a good plate of this tree, without number or description, bound at the end of the volume. Tradition says that a bet was made by a former Duke of Portland, that he had an oak so large, that a coach and four could be driven through its trunk, and the hole having been cut, he won his bet. When measured by Rooke it was, above the arch of the hole, 35 feet 3 inches in girth, the hole being 10 feet 3 inches high and 6 feet wide. Even at that time Rooke's figure shows it to have been a mutilated wreck, but the tree is still alive.

Near the Greendale Oak there is a magnificent though dead specimen of burr oak, about 50 feet high and 28 feet 9 inches in girth, and though all the veterans are long past their prime, there are still healthy growing oaks at Welbeck on the south side of the road to Norton, of which I measured one with a butt 32 feet high and 19 feet in girth, which Mr. Michie, the forester, considered would contain 500 feet in the butt alone. Such oaks have actually been cut and sold here in recent times; and I have a photograph, given me by Mr. G. Miles of Stamford, of a tree which he bought at auction for £40, and whose trunk measured 38 feet 6 inches long by 43¼ inches quarter-girth—equal to 511 feet 8 inches. It was so heavy that the weight on the wheels of the timber carriage broke through the road, and when brought to the station after much risk and trouble, the railway company refused to take it to Peterborough except on a special train by itself.

In Rockingham Park, Northants, the seat of the Rev. Wentworth Watson, there are a number of wonderful oaks, many of which are brown, and I had the opportunity, through the kindness of Mr. C. Richardson of Stamford, of seeing several of these felled in September 1903. He told me that, in the whole course of his long experience, he had never seen so many fine brown oaks together as these. The park lies high, on land which looks like oolitic limestone, the rock in some places coming near the surface; but where these oaks grow there is a good depth of loamy soil. Some of the trees which I saw lying were more or less hollow, and required no saw to bring them down. I was anxious to photograph one in the act of falling, and as the fellers were at work on one of the best, I asked them to let me know how long it would take; the roots only being then cut all round the tree. I expected that some hours would be required, but before the camera was fixed to take the tree as it stood, they suddenly called out, "stand clear," and down it came.

Plate 96 shows what the roots of these brown oaks are usually like, but if there is a foot or two of sound wood in the lower part, and the brown colour extends a good way up the trunk, they are still very valuable. I asked the fellers if they could tell a brown oak standing without boring it, and they said they could make a good guess at the colour, though they could not be sure. Probably long experience in a district where brown oak seems to be commoner than elsewhere, is the only guide, if there is one; but stories are told of men going in the night to bore such trees with an auger before trying to buy them, in the hopes of getting a bargain. From a statement sent me by Mr. Richardson, it appears that twenty-six of these trees were sold for £1100, five of them for £100 each, and contained about 8030 feet, all measured over bark, and nothing allowed for defects.

The best of this lot were eventually sold to Messrs. J. T. Williams of New York, and afterwards bought by the Pullman Company at a very high price. Mr. Richard Dean, of that Company, informs me that he considered the wood superior to any that they had previously used, and was good enough to send me some samples of the veneer made from them, which has been used in decorating their palace railway cars. The largest of these specimens measures 6 feet 1 inch by 2 feet 8 inches without a flaw, and is throughout of a uniform chestnut-brown colour, mottled with silvery patches, formed by the medullary rays, showing that it has been cut from a quartered plank.

The sandy and gravelly tracts in Essex have extensive woodlands, in which the oak is the principal timber tree. Sound oak trees with boles measuring from 16 to 20 feet in girth are scattered through the county. Oak trees of larger dimensions, many in a more or less decayed condition, have been measured and described by Mr. J. C. Shenstone.[1] Some of these I visited under his guidance in March 1907, and I think the following are worthy of notice:—At Thorrington are four trees from 27 to 31 feet in girth, decayed; at Danbury Park two trees of 31 feet in girth, decayed; at Hatfield Broad Oak the Doodle Oak, 42 feet in girth, decayed; at Havering-atte-Bower Bedford's Oak, 27 feet in girth, decayed; in Easton Park the finest tree is 80 feet by 23 feet, sound and vigorous, and there are many old pollards of great size. One of these, covered with burry growths, is 29 feet in girth; and another, on which the burr is very peculiar from its kidney-shaped lobes, is 33½ feet, of which the burr takes up 14 feet. At Marks Hall, near Coggleshall, the property of T. P. Price, Esq., there are very large sound oaks, as well as some relics of the ancient forest; the largest, which is perhaps the finest tree of its kind now standing in the county, is 90 feet by 24 feet 3 inches, and though some large branches are gone on one side it seems sound and vigorous. The only very large oak now left in Epping Forest is the Fairmead Oak, 30 feet in girth, and much decayed. At Thorndon Park, the ancient seat of Lord Petre, are many picturesque relics of the ancient forest; and at Wealside House, Brentwood, is an oak 27 feet in circumference of bole.

Mr. E. R. Pratt of Ryston Hall kindly sends me the following account of—

Kett's Oak at Ryston, Norfolk.—In the year 1547 this tree was the trysting-place of the West Norfolk rebels under the brothers Robert and William Kett. The former and the other "Governors" selected large oak trees under which their Courts sat to administer justice and regulate disorders. The Court in this case did not seem to look upon sheep-stealing as other than a necessary evil, since they left on the tree the following inscription:—

> Mr. Prat, your shepe are very fat
> and we thank you for that
> we have left you the skinnes.
> to buy your ladye pinnes
> and you must thank us for that.

	Dimensions in 1840.	In 1906.
On the ground level,	46 feet 6 inches.	49 feet 6 inches.
Three feet from the ground,	27 " 4 "	26 " 6 "
Five feet do.	24 " 3 "	23 " 11 "

From the photograph which accompanied this account it seems that the old tree is still fairly sound and vigorous. In an old map of the seventeenth century Kett's Oak is marked, showing that it was then known as a landmark.

Other remarkable oaks in Norfolk which I have seen are at Merton Hall, the seat of Lord Walsingham, where the largest, now much decayed, is about 27 feet in girth; at Blickling, where an oak in the kitchen garden 95 feet high, said by Grigor to have been planted by the Earl of Buckinghamshire, has a straight clean trunk 32 feet high and 15½ in girth; and at Stratton Strawless, where there is a beautiful straight-stemmed oak close to the house clean to 40 feet high and over 10 in girth.

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[1] *Essex Naturalist*, June 1904.

Cowthorpe Oak.—No oak in England has probably been the subject of so much writing as the Cowthorpe Oak, near Wetherby, which perhaps never was such a great tree as has been supposed, and is now a mere wreck. It has been figured several times, so that I need only refer those who wish to know more of it to a paper with illustrations by Mr. John Clayton, published in the *Transactions of the Botanical Society of Edinburgh*, 1903, p. 396. A comparison of the various measurements taken at different times shows great discrepancies. Mr. Clayton attempts to prove by a diagram that the decay of its roots have allowed it to settle into the ground, and thus explains the diminution in its girth, but the discrepancy between measurements taken by different people is considerable. The girth at 5 feet given by Marsham as 36½ feet in 1768, when no hollow or cavity is mentioned as existing in the tree, and the girth given by Mr. Clayton of 36 feet 10½ inches, at 5 feet 3 inches in 1893, are so nearly identical that I do not think Mr. Clayton proves his argument. Whether trees ever subside owing to the decay of their roots is to me a very doubtful point, and I have certainly seen oaks felled which, though of great age and completely hollow, were supported in their original position by a mere shell. I visited the Cowthorpe Oak in July 1906, and found that in its present condition no accurate measurement of it could be taken, a large part of one side having fallen in. I could see no evidence to support Mr. Clayton's idea that the base of the tree had sunk into the ground. The few living branches still bear acorns, from which some seedlings were raised in 1905 by Messrs. Kent and Brydon, nurserymen of Darlington.

The finest oaks in Yorkshire that I have seen or heard of are in the park at Studley Royal, which were described and figured by Loudon from drawings which I have seen in the Marquess of Ripon's library. Though I could not identify the drawings with trees now standing, Loudon gives the dimensions of the largest pedunculate tree as 80 feet by 24 feet 4 inches, and the largest sessile oak, which he says was then the largest in England, as 118 feet by 33½ feet. The best that were shown me were a pedunculate oak 80 feet by 23 feet, a good deal past its prime, and a sessile oak which I made 114 feet by 12 feet 2 inches, a vigorous and healthy tree.

One of the most remarkable oaks in England on account of its shape is the Umbrella Oak at Castlehill, North Devon (Plate 97). This tree had not altered materially during the recollection of the late Earl Fortescue, who lived to be over eighty, though it does not give the impression of very great age. It grows on a slope called Eggesford Bank, near the house, and has a clean bole about 8 feet by 6 feet 8 inches. The branches spread horizontally from one point, and form a close flat surface, of which the twigs are interlaced, and spread to a diameter of about 25 yards. Seedlings have been raised from its acorns, which do not produce this very curious habit, and attempts to reproduce it by grafts have not succeeded.

Another freak of nature is the Marriage Oak in Eridge Park, Kent, which Lord H. Nevill was good enough to show me. Here a yew and an oak have grown up together, though the two trunks, which measure 16 feet 3 inches in girth, have not combined, the yew having spread its branches widely over the top of the bole of the oak. A similar case is recorded by Mr. A. D. Webster[1] in the South Park at Holwood, Kent. Here the two trees have combined their stems into a normally shaped trunk, which girths 7 feet 10 inches at 5 feet, the yew being only 15 feet high, and spreading 36 feet, while the oak is 35 feet high with a spread of 54 feet.

Pollard oaks, when they are hollow at the top, sometimes support other trees of considerable size, which originate from seeds dropped by birds or brought by the wind. The best living instance of this that I know, is on an oak of no great size at Orwell Park, the seat of E. G. Pretyman, Esq., in Suffolk. This grows in a wood near the Decoy Pond, which is full of large self-sown hollies mixed with oaks, and looks as if it might be part of an original forest. Here a birch about 30 feet high, 20 inches in girth, is growing on the top of the oak, and has formed inside its hollow trunk what on one side seems to be a woody stem, whilst on the other side the roots are still in process of formation within the bole of the oak, which on that side is dead, but on the other has living branches.[2] Henry has seen a similar example on the road between Byfleet and Cobham, on Lady Buxton's property, where the birch, growing out of a stout oak bole, is 49 feet high and 8 inches in diameter.

Wistman's Wood.—After having said so much of big oaks, I must now mention one of the most remarkable oak woods in Britain, called Wistman's or Welshman's Wood, which is on Crockern Tor, Dartmoor, at an elevation of about 1400 feet. It contains a number, perhaps a thousand, of the most stunted and dwarf oaks in existence, growing among granite boulders in a very exposed and windy situation.

Wistman's Wood was described by Burt in his Notes to the second edition of Carrington's *Dartmoor*, p. 56, and also by Mr. W. Borrer.[3] I am indebted to Mr. E. Squarey of Downton, Wilts, for information in a letter to him by Mr. P. F. S. Amory of Druid, Ashburton, which brings our knowledge up to date, with photographs showing the curious appearance of these trees. The *Journal of Forestry*, v. 421, in a description of them, says that no acorns are produced; but Mr. J. B. Rowe, editor of the *Perambulations of Dartmoor* (ed. 1896), in 1895 found two acorns after a long search, one of which, planted at Druid on 9th November 1902, is over 4 feet high.

In September 1868 Mr. Wentworth Buller obtained leave from the Prince of Wales to cut down one of these trees in order to find out its age. One section was sent to Kew; and another now in Mr. Amory's possession is 9 inches by 7 in diameter, and shows 163 years' growth, with distinctly marked medullary rays and several deep shakes. The bark is extremely thin, probably owing to the thick coat of moss and lichen which covered it. The slowness of growth in this tree is remarkable, no less than forty years to the inch.

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[1] *Trans. Scot. Arb. Soc.* xii. 313 (1889).

[2] Compare Plot's account of a similar case quoted on p. 318 *supra*.

[3] Loudon, *loc. cit.* 1757.

STRUTT'S OAKS

Strutt in *Sylva Britannica*, published in 1822, figured no less than twenty-one oak trees, and as I have seen a good many of these myself, it may be interesting to notice their present condition after a lapse of over eighty years.

Plate 1. The Swilcar lawn Oak in Needwood Forest was then supposed to be about 600 years old, and was 21 feet 4½ inches at 6 feet, having increased 2 feet 4 inches in 54 years. When I saw it in 1904 it was about 25 feet in girth, but nearly dead at the top.

Plate 2. The Beggar's Oak in Bagot's Park, fully described above. It measured in 1822, 20 feet; in 1904, 24 feet 1 inch.

Plate 3. The Great Oak at Fredville was in 1822, at 8 feet from the ground, more than 28 feet in girth, and contained above 1400 feet of timber. Now, I am informed by the Rev. S. Sargent, who sends me a photograph, showing that it is in good health, it measures at 3 feet, which seems to be about its smallest girth, 33 feet 6 inches.

Plate 4. The Panshanger Oak, near Earl Cowper's house in Herts, seemed to Strutt to have scarcely reached its prime, though his plate shows that the spire was already dead. It measured in 1822, 19 feet at a yard from the ground, and was supposed to contain 1000 feet of timber. When I saw it in 1905 the topmost limbs were dead or dying, and there was a large rift in the trunk on one side. The girth was 21 feet 4 inches at 5 feet.

Plate 9. The Salcey Forest Oak was a mere wreck in 1822. I know not if it still exists.

Plate 10. The Abbot's Oak at Woburn Abbey was never a very large tree, but if it is the same that I saw in 1905 it remains sound.

Plate 11. The Chandos Oak at Michendon House, Southgate, was also not a first-class oak, though a very handsome one. It was then only 60 feet by 15 feet 9 inches. Henry's measurements in 1904 were 80 feet in height and 18 feet in girth, with a spread of branches 143 feet in diameter.

Plate 12. The oak called Beauty at Fredville, not a first-class tree among great oaks and figured with a dead top, measured only 16 feet in girth.

Plate 17. The Shelton Oak near Shrewsbury I have not seen. It was a hollow tree of great age, 26 feet in girth, in 1822, and I am told that it is now a mere wreck.

Plate 18. The Bounds Park Oak, near Tonbridge Wells, was a tree in perfect health and vigour when figured by Strutt, and measured 69 feet by 17 feet 9 inches at 12 feet. It is still standing, and as I am informed by Mr. H. J. Wood, has not much changed in appearance.

Plate 19. The Moccas Park Oak was much decayed in 1822, when it measured 36 feet in girth; it still survives, but is fast going to ruin.

Plate 20. The Wotton Oak was never a first-class tree, judging from the plate, and I do not know what is its present condition.

Plate 25. The Cowthorpe Oak has been already discussed.

Plate 26. Queen Elizabeth's Oak at Huntingfield in Suffolk is, I believe, the same tree which I saw on Lord Huntingfield's property, near the Hill Farm, Strutt quotes from Davy's letters but gives no measurement. It was quite hollow in 1773, and is now divided into three great sections which lean outwards and measure in all 39 feet 8 inches in girth. It has a few green and healthy branches, and the sound parts of the shell are about a foot thick.

Plate 27. Sir Philip Sidney's Oak at Penshurst, Kent, was, in 1822, a very old tree measuring 22 feet in girth.

Plate 28. The King Oak in Savernake Forest was quite hollow when figured by Strutt, and measured 24 feet in girth.

Plate 33. The Twelve Apostles at Burley Lodge, New Forest.

Plate 34. The Squitch Bank Oak in Bagot's Park was in 1822, and still is, one of the finest in England, and is now considered by Lord Bagot the best oak in his park.

Plate 35. Two trees called Gog and Magog near Castle Ashby still survive, and, judging from photographs of them sent me by Mr. Scriven, have not changed much in appearance, though Gog has apparently lost its bark on one side. Though very picturesque, they are not well-shaped trees. The former is now 58 feet by 28 feet, at 3 feet, with contents 1668 feet; the latter is 49 feet by 28½ feet.

Plate 36. The Tall Oak at Fredville is to my eye the best shaped of Strutt's oaks, though not of extraordinary size. He says the stem went up straight and clean to about 78 feet, and the girth at 4 feet was 18 feet.

Among the trees figured in *Sylva Scotica*, a continuation of the work just cited, there is only one oak, namely, Wallace's Oak at Elderslee or Ellerslie, near Paisley. Many larger and finer oaks than this occur in Scotland. Judging from the figure it is not remarkable except from its historic interest, which seems rather mythical.

THE OAK IN SCOTLAND

The oak rarely attains in Scotland the size and vigour so commonly met with in England.[1] Mr. Hutchinson[2] has catalogued 151 Scottish oaks, remarkable for size; and of these only six exceeded 20 feet in girth at 5 feet above the ground; the largest recorded by him, at Lee, Lanarkshire, was 23 feet girth at 3 feet up, the total height being 68 feet. The tallest oak recorded by Hutchinson was one at Hopetoun, Linlithgowshire, 110 feet high, with a bole of 93 feet, girthing 8 feet 8 inches, but I saw no tree approaching this height at Hopetoun in 1904. In Dr. Christison's[3] paper on the "Rate of Girth Increase in Trees," the average rate of increase is given for trees at the Edinburgh Botanic Garden; Craigiehall, Linlithgowshire; Pollok, Renfrewshire; and Methven Castle, Perthshire. The rate of course depends on the age of the trees, and is very variable even in the same locality. At

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[1] Sir Herbert Maxwell thinks that this is not owing to soil or climate, but to the fact that Scotland was denuded of trees before the seventeenth century. Planting was carried on slowly and sporadically after the Union, and there are few planted oaks in Scotland over 200 years old.

[2] *Trans. Highl. and Agric. Soc. Scot.* xiii. 218 (1881).

[3] *Trans. Bot. Soc. Edin.* xix. 461 (1892).

Methven, an oak planted in 1811 had attained, in 1893, 16 feet in girth, and during the last sixteen years had increased as much as 18 inches in girth.

The "Capon Tree,"[1] near Jedburgh, in 1893 was 22 feet 7 inches in girth at the narrowest part of the trunk. It divides at 6 feet into two stems, girthing 16 feet 2 inches and 10 feet 9 inches. The "Pease Tree" at Lee,[1] Lanark, measured, in 1890, 23 feet 7 inches in girth.

There is a fine oak at Methven Castle called the Pepperwell Oak, which Henry measured in 1904, 85 feet by 20 feet 4 inches. Colonel Smythe informed him that when his ancestor Peter Smythe was imprisoned in the Tower of London in 1722, his wife, though in sore straits for money, refused 100 marks for this tree.

In the shrubbery of Scone Palace, Perth, in ground which was formerly gardens belonging to a village, there is an oak, planted in 1805 (growing in black loam 4½ feet deep, resting on sand of unknown depth), which in 1904 was 102 feet high, 36 feet to the first branch, and 11 feet 4 inches in girth at 5 feet up. This shows unusually rapid growth. Near it is another oak, probably of the same age, 98 feet in height, 10 feet 8 inches in girth, with a bole of 25 feet.

The finest oak seen by Henry in Scotland is growing in front of the house at Blair Drummond, Perthshire, the seat of H. S. Home Drummond, Esq. It is 118 feet in height and 17 feet in girth, the first bough coming off at 24 feet up. This oak and a number of others near it probably date from some time after 1730, the year in which the house was built. At Drumlanrig, Dumfriesshire, there is an oak 16 feet in girth, with a bole of 22½ feet, which is estimated to contain 361 cubic feet of timber. At Dalswinton, Dumfriesshire, there are two remarkable oak stools, standing close together. The larger is 28½ feet in girth near the base; and gives off five great stems, 81 feet in height, which average 8 feet in girth.

(H. J. E.)

THE OAK IN IRELAND

The most famous oak wood in Ireland was that of Shillelagh in Wicklow, from which is derived the name formerly given to an oak stick, but now erroneously transferred to the blackthorn. From the wood of Shillelagh, according to tradition, were derived the timbers which roof Westminster Hall, and also those on the roof of the chapel of King's College, Cambridge. There is said[2] to be a record in St. Michan's Church, verified by "Hanmer's Chronicle" in the library of Trinity College, Dublin, which states: "The faire greene or commune, now called Ostomontoune Greene, was all wood, and hee that diggeth at this day to any depth shall find the grounde full of great rootes. From thence, anno 1098, King William Rufus, by license of Murchard, had that frame which made up the roofes of Westminster Hall, where no English spider webbeth or breedeth to this day." According to Hayes,[3] the finest trees in Shillelagh were cut down in the time of Charles II. and exported to Holland for the use of the Stadt House, under which hundreds of thousands of piles were driven. In 1692 iron forges were introduced into Shillelagh; and the ruin of the wood speedily followed. Great trees, however, still remained till near the end of the eighteenth century. At that time Mr. Sisson, who had purchased large quantities of timber, was given an oak tree of his own choice as a present, and this tree was so large that though forked at the base, each stem was big enough for a mill shaft at more than 50 feet from the butt. Two pieces being appropriated to this use, he sawed the remainder into panels for coach-building, which were sold for £250. In the MSS. of Thomas, Marquess of Rockingham, it is recorded that in 1731 there were standing in the deer park of Shillelagh 2150 oak trees, then valued at £8317, the timber being rated at 1s. 6d. a foot, and the bark at 7s. a barrel. In 1780 there remained of the old reserves 38 trees, which contained 2588 feet of timber. In the adjoining woods of Coolattin, in Hayes' time, there was a considerable number of young healthy oaks, several being 7½ feet in girth.

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[1] *Trans. Nat. Hist. Soc. Glasg.* 4th Sept. 1894.

[2] *Woods and Forests*, Jan. 28, 1885, Suppl. p. iii.

[3] *Practical Treatise on Planting*, 111 (1794).

I visited Coolattin in 1906 and was shown many fine trees, though none were of great thickness, the best tree seen being 118 feet high with a clean bole to 40 feet and a girth of 13 feet. All the trees were *Quercus sessiliflora*.

The largest oak wood in Ireland is in Viscount de Vesci's park at Abbeyleix, Queen's County, where there are several hundred acres of trees of the pedunculate species, growing very close together, especially on the alluvial flats along the river Nore. The trees are of no great height, and have usually short boles with wide-spreading, stout branches, the largest tree measured being 21 feet in girth.

Hayes gives several instances of the remarkable growth of oak in Ireland. At Ballybeg in Wicklow, a tree growing in alluvial soil, eighty years old, was 12 feet in girth at 8 feet from the ground. At Muckross, Killarney, six trees sown in 1760 measured in 1794, from 3 feet to 4 feet 11 inches in girth at 5 feet from the ground. Ireland, renowned in ancient days for its oak timber, which was valued abroad, is now singularly wanting in even good specimens of solitary oak trees; and Loudon gave in 1838 no examples of fine oak trees growing in Ireland. The finest which have been seen by me are:—At Dartrey, Cootehill, the seat of the Earl of Dartrey, a beautiful symmetrical pedunculate oak, 100 feet high with a girth of 14 feet 4 inches; at Kilmacurragh, Wicklow, a sessile oak 14½ feet in girth; at Glenstal, Limerick, a tree of the same species 16½ feet in girth; and at Shane's Castle, Antrim, a pedunculate oak 19 feet in girth. There are also many fine trees with good boles at Doneraile Court, Co. Cork, the largest about 13 feet in girth. (A. H.)

REMARKABLE TREES ABROAD

As the oak is one of the most characteristic British trees we give only a few details of the remarkable oaks which we have seen on the Continent. A good account of the trees in the forests of Retz, Compiegne, and St. Amand was written by Prof. Fisher in the *Trans. Eng. Arb. Soc.* v. 205. I took part in the excursion which this paper records, and saw the splendid sessile oaks at Compiegne, of which the one called the Czarina's Oak is the finest. This is as well-grown, but not a finer tree than some of those which I have described and figured in England, though in cubic contents inferior to several of them. The French measurements given on the trunk of the tree are—height 36 metres = 118 feet; girth at 1.30 metres, 5.20 metres = 17 feet; volume 32 cubic metres = 1130 feet; value £100. Mr. George Marshall, Past-President of the English Arboricultural Society, who is a timber valuer of great experience, estimated the butt of the tree to contain (46 feet by 42 inches quarter-girth) 550 cubic feet; plus 150 cubic feet for the top, making a total of 700 cubic feet; which, with the addition of an unknown quantity for the branches, always reckoned in France, plus 20 per cent for the difference between the total volume and the English quarter-girth measurement, will come near the French estimate. A photograph of an oak in the Forêt de Bellême was reproduced in this report. Its total height was 119½ feet, and its girth at 4 feet 6 inches was 9 feet 9 inches. It is impossible to imagine a tree containing more useful timber and less waste than this tree, which has rather the appearance of a gigantic mop than of an oak as we know them. Prof. Fisher considers Bellême as the finest oak forest in France, and in the *Gardeners' Chronicle*, xxviii. 220 (1900), speaks of a sessile oak which he measured there 146 feet high, with a clean bole 113 feet by 9 feet 10 inches girth, and a volume of about 500 cubic feet.[1]

Another renowned forest in France is that of Bercé near Chateau du Loir (Sarthe), visited by Henry in 1903 and in 1906, which covers 13,350 acres; and is made up of about 90 per cent of sessile oak and 10 per cent of beech. It is situated on a plateau; the soil being a deep loamy sand, poor in lime. There is not a single pedunculate oak in the forest itself, yet, curiously enough, all those in the hedgerows of the surrounding country are of this form. The sessile oak, owing to its ability to bear shade, is grown densely in the forest, and attains an astonishing height, though it is slow in growth, as far as regards diameter of stem, which averages at 200 years old only 20 inches. The best individual tree, the *Chêne Boppe*,[2] in 1905 measured 115 feet high, 75 feet to the first branch, and 14 feet in girth. Another tree, measured in 1906, was 125 feet total height, 92 feet to the first branch, and 8 feet in girth. In one section, containing a little less than twenty acres, there stood in 1903, aged 211 years, 1314 oaks and 268 beeches; the oaks averaging 28 inches in diameter. The total amount of the timber[3] was estimated by an accurate survey in 1895 at 275,000 cubic feet, valued at £14,720, or about £740 an acre. The yield of the first and second series in this forest, 2700 acres in extent, over which felling is done in sections once every 216 years, works out at 66 cubic feet of timber per acre per annum, equivalent to a net annual revenue per acre of £2 : 3s. A photograph taken by Henry, shows the shape of these forest oaks, all beautiful, clean, cylindrical stems, and illustrates the way in which the woodcutter, to save the seedlings beneath from damage, lops off the crown of the tree with an axe at a point below the first branch before felling the trunk.

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[1] Henry visited Bellême in 1906, and does not consider it to be quite as fine a forest as Bercé. The best tree seen, possibly the same as the one measured by Prof. Fisher, was 125 feet total height, 95 feet to the first branch, 10 feet 4 inches in girth, and about 425 cubic feet in volume. On referring to Prof. Fisher as to this measurement, he sends me two photographs given him by M. Granger, then Garde Général at Bellême, representing (1) the Chêne de Brigonnais, which is 37 metres = about 120 feet high; girth at 4 feet 6 inches, 3 metres = 9 feet 10 inches; height to the first branch, 23 metres; (2) the Chêne Lorentz, which is 40 metres in height = about 130 feet, girth 4½ metres = about 14¾ feet, and 18 metres long to the point where it divides into two nearly equal stems. It therefore appears that we have in England a few oaks at least as tall, and many larger in bulk than any recorded in France.

[2] Near this tree Henry observed an oak bearing misletoe on a branch at 60 feet up.

[3] Huffel, *Economie Forestière*, i. pp. 370, 372 (1904). The capital or volume of wood in the forest is not diminished by its felling, but is steadily increasing slightly all the time, owing to careful management.

The oaks in the German forest of Spessart have been so frequently mentioned by recent writers on Forestry that I need not say anything of them, but doubt whether they equal the oaks in some of the few remaining virgin forests of Slavonia. In 1900 I saw a splendid lot of clean straight logs 3 to 5 feet in diameter, which had been felled in these forests, and floated down the Save to Bosnabrod.

We are indebted to Dr. Simonyi Semadam Sandor, a member of the Hungarian Parliament, for an account of the oaks of Slavonia in the Forest of Brod Petevarad, which is published in a Hungarian journal called *Erdzesti Lapok*, at Buda Pesth, June 1889, with photographs showing splendid clean-stemmed trees, 30 to 40 metres high, and 2 to 3 metres in diameter.

The European oak seems able to grow well in temperate parts of the southern hemisphere. In Chile it seems as much at home as in Europe, and not only grows much faster, but reproduces itself with such ease from seed on land capable of being irrigated that I saw no reason why it should not be cultivated for its timber.[1]

In South Africa the original Dutch settlers planted oaks near Cape Town, and under one of these trees the Convention was signed by which the Colony was transferred to Great Britain in 1814. On 5th April 1905 my brother posted me a few acorns from this tree, the trunk of which is now hollow and bricked up. I sowed them in May to see whether they would at once revert to their proper season of growth; and out of twenty acorns, three germinated in June, and are now nice young trees, the others never coming up at all.

In North America I have seen no European oaks of any great size, though there is one in Prof. Sargent's grounds near Boston, which has puzzled several good botanists as to its origin.

INJURIES TO OAKS

The liability of the oak to be struck by lightning was noted by Shakespeare, who, in *King Lear*, Act III. Scene ii., wrote—

> You sulphurous and thought-executing fires,
> Vaunt-couriers to oak-cleaving thunderbolts.

Mr. Menzies says,[2] "Of all forest trees oaks are, in my experience, the most dangerous. If they have a large spreading head, they are shivered into shreds when struck. If they have long tapering stems, and thus can act almost as conductors, they are not so dangerous, and the lightning will run down the side, ploughing out a deep furrow. I have once seen a beech struck, an ash once, an elm once, a cedar of Lebanon once, but never any other trees, except the oak. And while the others stood comparatively singly in an open space, the oaks have been selected and struck in the midst of a thick wood."

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[1] Sir W. Thiselton Dyer informs me that on the Blue Mountains of Jamaica Sir Daniel Morris found a characteristic English oak.

[2] *History of Windsor Great Park*, p. 8.

Several interesting particulars of the effect of lightning on oaks are given by Loudon, who also states that the oak, owing to its roots not being so liable to rot in the ground as those of most trees, is not often blown down. He describes the effect of a hurricane in October 1831, on the splendid oaks growing in Lord Petre's park at Thorndon Hall in Essex, which reminds me of a similar case in April 1890, when I saw, at Narford, in Norfolk, oaks of 2 to 3 feet in diameter broken off at 4 to 10 feet from the ground by the force of the wind, which tore up many plantations of spruce and other shallow-rooting trees by the roots.

Sir Charles Strickland tells me that a very tall young oak tree 54 feet to the first branch, and quite straight, growing at Housham in Yorkshire, nearly on a level with the river Derwent, was, in the severe winter of 1860-61, completely killed by a frost which was the severest in his recollection. Though he has no record of the temperature at Housham, yet he believes that at Appleby, in Lincolnshire, it was as low as 15½ below zero,[1] and generally in the northern counties the thermometer went below zero. Many other oaks were killed in the woods and in the hedgerows between Malton and Pickering by the same frost.

The various insects which attack the oak are too numerous to be mentioned in detail, but are described at length by Loudon and by many other authors.

The galls, which are so common on the leaves, are produced by several species of Cynips, and the so-called oak-apples are the result of an injury by an insect of the same family.[2]

MISTLETOE ON THE OAK

Since the time of Pliny, who describes the worship of the oak, and especially of the mistletoe-bearing oak by the Druids, the occurrence of this parasite on the oak has always been looked on as a rarity. Loudon only mentions two trees known to him, of which one near Ledbury was cut down in 1831, and another at Eastnor Castle is still living; but we have now been able to collect many more authentic records. A paper on the subject by the late Dr. Bull of Hereford[3] gives particulars of several, and states that it is considered a dangerous practice to interfere with a mistletoe-bearing oak. One at St. Diels, near Monmouth, was cut down by the bailiff about 1853, and the owner of the estate immediately dismissed him. A woodman who climbed the Eastnor tree to get some mistletoe, fell down and broke his leg, and other similar stories are quoted. The finest mistletoe oak I have seen was shown me by Sir George Cornewall, at Bredwardine, in 1902. When described by Dr. Bull, mistletoe was growing on it in no less than fifteen different places, and it measured 78 feet by 11 feet 6 inches in girth. Sir George has lately found another in his park, and has a third on his estate in Woodbury Wood.

This part of England seems to be, for some reason, the most prolific in England in mistletoe oaks; and it will be observed in the list which follows that there are none reported in the northern half of Great Britain.

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[1] This is a little lower than any temperature recorded by the Meteorological Office, but the subject of meteorology as affecting trees will be discussed fully later.

[2] An article in the *Kew Bulletin of Miscellaneous Information*, Additional Series, v. 1906, on Oak Galls, by R. A. Rolfe, gives much information on the subject, but is too long to quote. Nearly one hundred different kinds have been described which occur on the roots, buds, leaves, stamens, ovaries, and fruit.

[3] *Trans. Woolhope Nat. Field Club*, 1870, p. 68.

The subject has been recently studied by M. H. Gadeau de Kerville,[1] who records in Normandy alone no less than 26 mistletoe-bearing oaks, living or recently felled, of which a list with exact particulars of their locality is given, pp. 298-301. An excellent illustration of one of the finest of these growing on the farm of Bois, at Isigny-le-Buat, Department of Manche, shows a large and well-shaped tree, about 60 feet by 16 feet, of the pedunculate variety, which is covered with tufts of mistletoe, some of them growing on the trunk, and of very large size. M. de Kerville estimates the age of this tree at 200 to 300 years, and says that it has begun to deteriorate, as the dead branches show. M. Eugène Ormont states that a tuft of mistletoe of about a foot in length, which he examined on an oak, was eleven years old and seemed slower in its growth and yellower in colour than mistletoe growing on the apple.

LIST OF REPORTED MISTLETOE-BEARING OAKS IN ENGLAND[2]

Locality.	Authority.	Date.	Particulars.
Bredwardine, Hereford,	Dr. Bull, H. J. E.	1870 1902	
Moccas Park, do.,	Rev. Sir G. Cornewall,	1904	
Woodbury Wood, do.,	do.	do.	
Tedstone Delamere, do.,	Dr. Bull,	1870	
Haven in the forest of Deerfold, do.,	do.,	do.	
Badham's Court, near Chepstow, Monmouth,	do.,	do.	
Near the Hendre, Llangattock, do.,	do.	do.	This tree is not known to exist now, so far as I can learn, at the Hendre.
Eastnor Castle, Worcestershire,	do., H. J. E.	do. 1903	
Lindridge, Worcestershire,	*Leisure Hour*,	1873	
Frampton-on-Severn, Gloucestershire,	H. Clifford, Esq.,	1904	Mentioned by Lees in 1857, and still living.
Knightwick Church, Worcester,	*Leisure Hour*,	1873	
Plasnewydd, Anglesea, in Marquis of Anglesea's Park,	Lees,	1857	
Hackwood Park, Basingstoke, Hants,	*Leisure Hour*,	1873	
Lee Court, Kent,	do.,	do.	
Burningfold Farm, Dunsfold, Surrey,	do.,	do.	
Bodlam's Court, Sunbury Park, do.,	do.,	do.	
Shottesham, Norfolk,	Francis, in Trimmer's *Flora of Norfolk*,	1866	
Alderley, Norfolk,	Winter, in do.,	do.	
Not far from Plymouth, by side of S. Devon railway,	Britten,	1884	
Near Cheltenham,	*Leisure Hour*,	1873	I can get no confirmation of this.
Seven miles from Godalming,	Menzies,	1860	

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[1] *Les Vieux arbres de la Normandie*, pt. iv. (1905).

[2] Sir Herbert Maxwell in *Memories of the Months*, p. 285, mentions the existence of mistletoe-bearing oaks at Stoulton in Worcestershire, in Sherwood Forest, Windsor Forest, and Richmond Park.

BARK

The bark of the oak was until recently a valuable source of revenue in England, but, owing to the introduction of other materials for tanning, has now fallen so much in price that in some districts it hardly pays to take off, and large areas of coppice oak in the western counties have become almost worthless in consequence. Whether the leather made by these modern substitutes is as durable as that produced under the old system is doubtful, but the comparative slowness of the process of tanning by oak bark seems to be one of the chief reasons for the change.

Professor H. R. Procter of the Leather Industries Department of the Leeds University, whom I consulted on this question, tells me that though he agrees with me that no tree at present grown in England is worth growing for the sake of its bark alone, yet he thinks that it will be long before the demand for oak bark entirely disappears. He considers that though leather tanned with oak bark alone is perhaps the best for boots and shoes, the cost of the slow process is so much greater in proportion to quality, that the leather so tanned is practically an article of luxury.

In the *Land Agents' Record* for October 29, 1904, there is an article on the price of oak bark, which is stated to have fallen from £8 a ton in the writer's experience to 47s. 6d.; and when the cost of peeling, which averages about 25s. per ton, the cost of loading and delivering to the station, and the cost of railway carriage is added, little or nothing is left for bark grown at any distance from its market. Since then the price in some districts has risen a little, but in this case, as in others, it is clear that chemically prepared substitutes are killing an industry of much importance to landowners and labourers.

TIMBER

With regard to the difference in the timber of the two varieties of oak, we have, strange to say, little or no certain experience in England. Laslett says that though he agrees generally with the opinion then prevalent, that *Q. sessiliflora* was slightly inferior to *pedunculata*, he feels bound to admit that during a long experience in working them, he has not been able to discover any important difference between the two varieties. He says that very fine specimens of long clean oaks of the sessile form were found in the Forest of Dean, which, however, were liable both to cup and star shake, and that he is inclined to believe that these defects are less common in *Q. pedunculata*.

Though little attention is now paid to the difference of winter- and spring-felled oak timber, and it seems as if most users of wood will pay as much for the latter as for the former, yet, considering the low price of bark and the importance of durability, I should strongly advise the former being used for all first-class work.

Laslett,[1] who, as timber inspector to the Admiralty, had probably as much experience as any man of his day, and more than any one at the present time, gives in chapter xi. many proofs in support of his opinion that winter-felled oak is better than spring-felled; though the practice he recommends was to bark the trees standing, and fell them in the succeeding winter, a custom which is still followed in some parts in England. He also states, on page 73, that having carefully examined and compared many pieces of both winter- and spring- or summer-felled logs, he found almost invariably that the winter-cut timber, after being a few years in store, was in better condition than that which had been cut in the spring. "The winter-felled logs were sounder, less rent by shakes, and the centres or early growths generally showed less of incipient decay than the spring-felled."

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[1] By far the best account that I know of is in Laslett's *Timber and Timber Trees*, of which a new edition, revised by the late Prof. Marshall Ward, was published in 1894.

So much has been written about the timber of the oak that it seems unnecessary to go into very great detail with regard to this subject, especially as this timber, of which little is now required for the navy, is being ousted by iron and by cheaper imported timber from many of its former uses, and is of far less value than formerly; but though at the present time English oak is out of fashion, there is no doubt that such durable and beautiful wood must always have a considerable value to those who do not sacrifice durability to cheapness, and who have patience to wait until it has been properly seasoned, which requires from two to six years according to the thickness of the plank.

There are so many proofs of its everlasting character in the form of roofs and in the old timbered buildings which are common in Cheshire, and of which so many beautiful illustrations are given in *Country Life*, that I need not repeat them, but an extraordinary instance of its longevity when exposed to the weather was pointed out to me by the late Lord Arundell of Wardour in the ruins of Wardour Castle. This building, according to an account of it published in *The Antiquary*, November 23, 1873, was inhabited before the reign of Edward III., and was besieged and sacked by the Parliamentary army in the reign of Charles I., and blown up by its owner, Lord Arundell, in 1644, rather than allow it to remain in the hands of the enemy. An oak lintel, which must therefore have been exposed to the weather for 260 years, still remained *in situ* in 1903, and as far as I could see from below was not much decayed.

In a paper by W. Atkinson[1] it is said that during the last thirty years he had taken every opportunity of procuring specimens of wood from old buildings, and particularly what the carpenters called chestnut, but never in a single instance had he seen a piece of chestnut, the wood so called being always that of *Q. sessiliflora*, mistaken for chestnut from a deficiency of the flower or silver grain. He goes on to say: "The roof of Westminster Hall has been said to be chestnut; while it was under repair I procured specimens from different parts of the roof, the whole of them were oak, and chiefly the *Q. sessiliflora*. Most of the black oak from trees dug out of the ground I have found to be of the same kind. From finding the wood of the oldest buildings about London to be chiefly of the *Q. sessiliflora*, I should suppose that some centuries ago the chief part of the natural woods were of that kind; at present the greater part of the oak grown in the south of England is *Q. pedunculata*. Specimens of oaks that I have procured from different parts of

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[1] *Trans. Hort. Soc.* Second Series, i. p. 336 (1835).

Yorkshire and the county of Durham have all been *Q. sessiliflora*, which is very scarce in the south. There are some trees of it at Kenwood, the Earl of Mansfield's, near Highgate, which I believe to be one of the oldest woods near London, and a greater part of the *Q. sessiliflora* appears to be trees from old stools." To this the Secretary, Mr. G. Bentham, adds a note, as follows:—"Mr. Atkinson's opinion on this subject is confirmed in a remarkable manner by the discovery that the oak in an extensive submarine forest near Hastings is *Q. sessiliflora*."

Brown Oak

In a paper on British timber which I read before the Surveyors' Institution in February 1904,[1] I called attention to a form of oak timber, known as "brown oak," which does not appear to have been much noticed by any previous writer.[2] Though after very careful investigation I have failed to ascertain with certainty the causes which produce it, I am inclined to believe that it is not, as some have thought, caused by a fungus; though spores of some fungoid mycelium are often found running through it; but that the change of colour is produced, especially on certain soils and in certain localities, by age. And though I have evidence that in exceptional cases the heartwood of quite young oaks is brown,[3] the majority of the trees which produce this beautiful and valuable wood are in an incipient stage of decay, and often hollow, leaving only a shell of more or less sound wood. The change of colour in some trees commences at the ground and extends upwards, or less commonly begins in the upper part and extends downwards. No one can be certain, without boring or felling the tree, whether the wood is brown or how far the colour may extend; but if the tree is allowed to stand too long after it has become brown it loses its "nature," to use a carpenter's expression, and is often so shaky and full of cracks that it is of little use. The sapwood always remains of the normal colour. But when a brown oak of good rich colour contains sound and solid timber it is superior to any wood I know for the interior decoration of houses, and for the making of sideboards and other heavy furniture.

Until about fifty years ago this wood was little valued in England, and I am told that on the Duke of Bedford's estate its use was prohibited in building contracts because it was supposed to be unsound. Even now it is hardly known or recognised as valuable except in certain parts of England, and is often sold far below its real value by inexperienced persons. But the Americans have created such a demand for it, that most timber merchants are now quick to appreciate the difference between brown and common oak, and the best qualities of it are sometimes sold for as much as 10s. per cubic foot.

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[1] *Trans. Surveyors' Institution*, vol. xxxvi. pt. vii.

[2] Laslett, ed. 2, p. 96, only says of it, "and even when in a state of decay or in its worst stage of 'foxiness,' the cabinetmaker prizes it for its deep red colour, and works it up in a variety of ways."

[3] Mr. Alexander Howard tells me that he has seen a group of young oaks felled in Essex, which were not more than 12 to 18 inches in diameter, all perfectly sound, in which the wood was of a rich brown all through the trunk up to and beyond the first main branch. He purchased near Chelmsford a very fine oak which had no less than five secondary trunks growing out of the butt, all of a very rich brown colour, and a number of younger trees growing near it in the same park also proved to be of the same colour. Thus it seems that though the conditions of the soil have some influence, yet the colour may in some cases be inherited. Mr. Howard has inquired for many years but never heard of a brown oak on the continent, and believes it to be only found in this country. Some woodmen in Essex have thought that the trees which carry their leaves longest in winter produced "red oak," which is the local term for brown oak, but I could get no definite proof of the truth of this idea.

When the wood shows the blackish streaks running through it, which is known as tortoise-shell grain, it is most valued for cutting veneers. These are laid in thin sheets on other wood, partly to make it go farther, and also because this wood is so difficult to season properly, and so wasteful in conversion that it is not safe to use in the form of thick boards.

My friend, Dr. Weld of Boston, U.S.A., who is a great connoisseur and admirer of fine woods, and especially of brown oak, showed me at his house the most magnificent specimens of panelling and wainscoting, done under his own supervision by Messrs. Noyes and Whitcombe of Boston, with oak which he selected and purchased himself in England. In their works I saw a quantity of carved brown oak pews, and a very large brown oak organ front designed by Mr. C. Brigham, architect, of 12 Bosworth Street, Boston, for a memorial church at Fairhaven, Mass. Mr. Whitcombe was good enough to show me the manner in which the boards are seasoned after they are cut from the logs, which are imported in the rough as an unmanufactured product to escape the heavy duty. Dry white pine boards fresh from the hot-air kiln are laid on each side of the oak boards, and properly stripped in an open covered shed. When the moisture has been partially absorbed, they are all turned over and again sandwiched between fresh dry pine boards; thus saving a great deal of time, which is rarely given to season timber properly in America, and preparing the wood to stand the conditions of dryness, which are more trying to furniture in American than in English houses.

Mr. C. M'Kim, a distinguished American architect, writes me as follows respecting English oak:—"We regard it as the most beautiful oak in the world, costly because of its scarcity and the duties imposed upon it; requiring the best workmanship in putting it together; but preferred above all others for its finer quality, richer colour, and endurance. The most important and dignified panelled rooms in this country are furnished in English oak." I also was pleased to find that the great dining-room in the White House at Washington is completely panelled with English brown oak.

Mr. F. H. Bacon of the A. H. Davenport Company of Boston, one of the best firms for cabinet work in the United States, writes:—"Mr. Davenport has been using it in his business for at least thirty years, and we think it is a wood which will always be in demand, as a room furnished with English oak has a richness and depth of tone which is impossible to get with any other oak. The wood is becoming more expensive, but I think it will always be used by people who can afford it. It is difficult to work; the plain surfaces are generally veneered. It stands perfectly well without warping and twisting, and is not attacked by worms as walnut wood is."

The best example that I have seen of fine brown oak work in England is at Rockhurst, the residence of the late Sir Richard Farrant, in Sussex. This was done by Marsh, Cribb, and Company of Leeds, with brown pollard oak, showing very varied figure, and superior in this respect even to that of Dr. Weld's house.

This wood requires no varnish, but when simply polished with wax and shellac only, in the manner adopted by Dr. Weld, is as rich as any mahogany. It is to some extent imitated by a practice called fuming, which is now very commonly used to give a darker colour to foreign oak, and thus make it resemble old oak, which has become so fashionable; but fumed oak can easily be distinguished from, and is far inferior to real brown oak, which also varies a good deal in colour when new.

POLLARD OAK

There is another form of oak wood usually called pollard, which is produced from the burrs or swellings which often appear on old oaks, especially in very dry and in wet ground. The real cause of these excrescences is not yet fully explained; but in some places, and especially in Sherwood Forest, they are very common, and when cut, show a twisted and contorted grain, sometimes full of little eyes which resemble those of the so-called "birds'-eye maple," a variety of the wood of American maple, of which we shall speak later.

Pollard oak is usually full of little cracks, and is best cut into thin slices or "plating" $\frac{1}{8}$ inch thick or less. When polished the little cracks are filled up, and when the wood is mottled with brown, yellow, and pink in various shades it is very beautiful. An oak of this type, which was only about 10 feet high and 9 feet in girth, grew on Chedworth Downs, Gloucestershire, and was given to me by the Earl of Eldon. Its wood, when cut into veneer, was throughout the whole thickness of the tree more like that of birds'-eye maple than oak, and has served to make the front of a very handsome bookcase.

OAK PANELLING

I cannot pass from this subject without alluding to the use of English oak for panelling walls, a practice which was almost universal in houses built in the sixteenth and seventeenth centuries, and of which many beautiful examples still exist. Modern architects, however, do not seem to have properly appreciated, that the beauty and fitness of oak for such work depends on the extent to which the "figure," "flower," "silver grain," or "flash" is shown—all these terms are used to express the bright glossy patches and lines which the medullary rays of oak show when cut "on the true quarter."

In our ancestors' time, when roads were bad or non-existent, and when sawmills were unknown, it was necessary to cut up large oak trees where they fell, either by digging a saw pit near or under them, or by cross-cutting them into suitable lengths, and then "rending," cleaving, or splitting them into slabs. This practice is now adopted principally for making oak palings and for wheel spokes, which are much stronger when rent than when sawn; but it will be found on examination of the back of old panelling that it was usually rent, and as you can only cleave oak on the line of the medullary rays, the figure shown by rent oak is much better and more abundant than when sawn on the quarter, and though the practice is more wasteful and is only possible in the case of straight-grained trees, yet it should certainly be tried by those who admire finely figured oak.

Strange to say, the importance of selecting and matching the figured pieces, and of placing them in the most conspicuous positions, does not seem to be noticed, for I have seen in modern houses, and in old castles on whose restoration no expense has been spared, panelling in which new and plain pieces have been introduced amongst splendid old panels, and finely figured new and old panels put in dark corners where they were unseen. When one considers how small a proportion the cost of the wood bears to the workmanship, it is extraordinary that this should be allowed, or that American oak should be used, as I have seen sometimes done, in restoring ancient houses, when infinitely better and more beautiful wood was growing, and often rotting on its roots, within a very short distance.

Experienced cleavers are not to be found in every county, but in Kent, Surrey, Sussex, and Hants, and where rent oak palings are much used, as in the neighbourhood of London, such men may be found, who with a tool called a "break-axe" or "flammer," will convert straight-grained oak into slabs of suitable dimensions for panelling, which, when properly seasoned, show better figure than sawn timber. For this purpose logs of not less than three feet diameter should be selected, as straight as possible in the grain, and cut into the lengths of which the panels are required. The slabs come out rather irregular in size, and are, of course, much thicker on the outside. They should be carefully piled for about twelve months in a dry, airy place, when they can be reduced by a thin circular saw and by planing to the proper thickness, choosing whichever side shows the best figure for the face. Longer and narrower pieces, either rent or sawn, must be selected for the stiles and rails, and if put together by a competent joiner, I can say from experience that the effect will be much superior to work done by the best London firms with foreign timber, especially when brown oak can be found fit for rending.

The diagram, Fig. 1, on the following page shows the best method of rending oak to show its fine figure.

For quartering by the saw different methods are adopted, the best being that shown on the following page, Figs. 2 and 3, taken, by permission of Messrs. Rider and Son, from a very useful little book.[1] By this method, which, though rather wasteful, produces the best results, only the central boards of each cut are on the true quarter, and the others are narrower, and more or less across the natural line of cleavage.

Of the different styles of oak panelling it is not my intention to speak, but it seems to me that elaborate carving is out of place in such wood as this, which wants no extraneous adornment. Many beautiful specimens of ancient panelling in various styles may be seen in the galleries of the South Kensington Museum, among which that taken out of Sizergh Castle, Westmoreland, is, though rough in workmanship, a good example of ornamentation with native wood.

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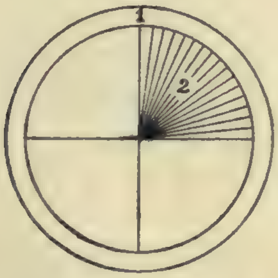
[1] *English Timber and its Economical Conversion*, London, 1904.

One of the most elaborate instances of room-decoration in woodwork of old times is seen in the dining-room at Gilling Castle, near York, formerly the property of the Fairfax family, now belonging to W. S. Hunter, Esq. It is a room about 30 by 20 feet, and is panelled with large panels of oak, in oblongs 2 feet 4 inches wide and 3 feet deep, surrounded by heavy carved mouldings. Each panel is inlaid with highly intricate and varied geometrical patterns in narrow lines of black and white wood, which I believe to be bog oak and holly, inlaid in narrow lines, and forming an elongated diamond in the middle of the panel. The four corners of each panel are also inlaid with flowers done in similar wood. This work runs from the ground up to about 10 feet high, above which an elaborate decoration in colour, containing many family trees and coats of arms, reaches to the ceiling. Some good judges think this is the most beautiful room in England, but without resorting to such minute and fanciful patterns, I may safely say that good plain oak panelling, in which the stiles and rails are duly proportioned, and the silver grain well matched in each panel, gives not only the handsomest and richest effect of any wall covering I know, but is also the most durable, improving in colour with age, and if done with one's own timber, affords an interest which no Italian frescoes or plaster work can give.



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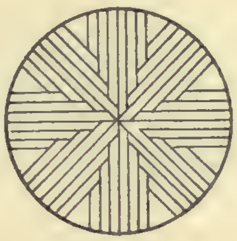

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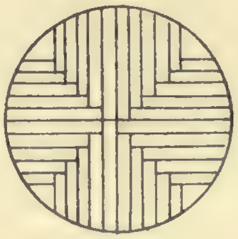

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FIG. 1. (1) Sapwood; best taken off. (2) Feather-edged boards somewhat variable in width and thickness, but following the natural line of cleavage on the medullary rays of the wood.

FIGS. 2 and 3. Methods of quartering by the saw.

In the chapel, in the hall, and in the Earl's study at Powderham Castle, Devonshire, are very good examples of pews and panelling, both of the linen pattern and carved panels, but though the linen pattern was once a favourite one, and is still copied by some decorators, it seems to me a mistaken notion to imitate the folds of a textile material in wood, and especially in oak.

WAINSCOT OAK

What is usually known under this name was for many years imported from the Baltic seaports of Dantzic, Riga, and Libau, and was the produce of forests in the interior of the Russian Baltic Provinces, and of Russian Poland, from whence it was brought to the coast by water, until railways were made. According to Laslett, the Riga timber, though of moderate dimensions, had the medullary rays more numerous and better marked than the Dantzic oak, and came to market in the form of hewn billets of about 18 feet.

But as the supplies of this oak became less, and the demand greater, a fresh source of supply was found in Slavonia and South Hungary, which for many years has furnished about half the total import through the ports of Trieste and Fiume. Mr. A. Howard tells me that the size and quality of this was better than the Baltic oak, but owing to the Austrian Government having recently diminished their cuttings in consequence of the rapid diminution of mature timber, a large quantity of billets are now exported from Odessa, which are believed to come from the forests of Podolia and Volhynia, and other provinces of South-West Russia.

All this imported oak is milder and more easily worked than English oak, and as only selected logs free from knots are shipped, it can be converted into boards with less waste and risk than home-grown timber. We have no certain evidence as to the existence of a sufficient quantity in Russia to keep up the supply either from the Baltic or Odessa, and though the more scientific foresters of Austria are taking steps to restore their oak forests by natural regeneration, it is probable that the French, who consume an immense quantity of oak from this region, will take all they can get, and this, coupled with the approaching disappearance of American oak large enough for quartering, must, sooner or later, cause our own timber when long and clean to be much more valuable than it is at present.

A note in Holinshed's *Chronicles*,[1] vol. i. p. 357 (ed. 1807), seems to show that wainscot oak was already exported from the Baltic as long ago as Queen Elizabeth's reign, but whether "Danske" means that it came in Danish ships or from the port of Dantzig I cannot ascertain, though Colonel Brookfield, H.B.M. Consul at that port, has made inquiry on the subject.

Laslett is the only practical English writer I know of who was personally acquainted with the oak in its native forests in the east of Europe, having been employed by the Admiralty to survey the forests near Brussa, in Asia Minor, as well as in Bosnia, Herzegovina, Croatia, Styria, and Hungary. He states that in the

[1] According to Mr. J. C. Shenstone, Harrison of Redwinter in Essex, who lived in the reign of Henry VIII., was the author of this note. "Of all oke growing in England the parke oke is the softest, and far more spalt and Prickle than the hedge oke. And of all in Essex, that growing in Bardfield parke is the finest for joiner's craft; for often times have I seene of their workes made of that oke so fine and faire as most of the wanescot that is brought hither out of Danske, for our wanescot is not made in England. Yet diverse have assaied to deale with our okes to that end, but not with so good suceesse as they have hoped, because the ab or juice will not so soone be removed and cleane drawne out, which some attribute to want of time in the salt water."

forests south-east of Brussa he found oaks resembling the English *Q. Robur* on the upper ranges of the mountains, while in the valleys *Q. Cerris* or the mossy-cupped oak was found. In Austria, he says, that in the Kogarate mountains, and in the district between the rivers Verbas and Okvina they were chiefly of the sessile variety, mixed occasionally with *Q. Cerris*, and all of straight growth with long clean stems, generally of good quality, but at that time no attempt had been made to utilise them except for cleaving cask staves.

Of all the oaks of which trials were made in our Government dockyards during the period at which British oak became scarce, Laslett says that the white oak of North America compared very favourably with all the foreign oaks, but proved to be slightly inferior in strength to English oaks.

Bog Oak

This is obtained from trees which have been buried in peat bogs for centuries, and which has become blackened by the peat water. It is very commonly found in Ireland, and in some parts of England and Scotland. When large and sound enough it is used for furniture, picture frames, and for small ornamental work, but as a rule is so full of shakes, and cracks so much in drying after it is dug up, that it is of no use for cabinet-making except in the form of inlay, or marqueterie. Occasionally, however, fine sound logs are dug out, which if slowly seasoned in an airy cellar may be used for larger work. One of the best examples I have seen of black oak was a door exhibited by Mr. E. R. Pratt of Ryston at the Royal Agricultural Society's Show at Park Royal in 1905, made from oak found on his property in Norfolk. He tells me that the planks after being sawn are dressed two or three times with "fuel" or "dead" oil which replaces the evaporated water by the refuse of petroleum, a substance theoretically similar to that lost by age. The result is certainly very successful.

Many cases have been recorded and published of the great durability of the timber of the oak under ground and under water; but I have come across no relic of the past so interesting in this respect as the prehistoric boat which was dug up at Brigg, in Lincolnshire, in 1884, when digging a foundation for a gasometer. This has been well described by the Rev. D. Cary Elwes in a lecture, which was published in 1903,[1] and a photograph of it is published in a recent pamphlet by the Rev. A. N. Claye,[2] for which I am indebted to Miss Woolward. This wonderfully preserved dug-out was hollowed out of one huge oak log 48½ feet long, and approximately 6 feet in diameter, which showed no signs of branches, a log which must have contained nearly 1000 feet of timber, and which could not be matched now in England, or, so far as we know, in Europe or North America. The boat is 4 feet 3 inches wide by 2 feet 8 inches deep at the bows, and 4 feet 6 inches by 3 feet 4 inches at the stern, which was the root end of the tree. The sides are about 2 inches thick, the bottom 4 inches at the bows, and as much as 16 inches at the stern. The stern piece was ingeniously fitted in, though not found *in situ*, and a large rift on one side had been still more cleverly repaired with wooden patches caulked with moss. No metal had been used in any part of it. The boat was found embedded in the blue and brown clay which underlies the peat, and is considered on geological evidence, which is given with great detail, to be from 2600 to 3000 years old. It was offered by Mr. Cary Elwes to the British Museum, but was declined as being too large; it is, however, now suitably housed at Brigg.

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[1] *A Prehistoric Boat.* Stanton and Son, Northampton.

[2] *Brigg Church and Town.* Jackson, Brigg.

Many similar oaken boats of smaller dimensions have been discovered in various parts of England, and I saw one myself which had been just dug out of a peat bed close to Shapwick Station, in Somersetshire, in September 1906, which was 20 feet long by 2 feet 10 inches wide.

At Brigg an ancient causeway was discovered, which is described by Mr. Claye in the same pamphlet, and a photograph given. This roadway was found in a brickyard lying between the two branches of the river, under a deposit of blue alluvial clay, and above the forest bed which lies on the top of the glacial drift, and was probably made by the early Britons to secure a safe passage across the valley when it was little more than a swamp. Small trees and branches of yew were laid lengthwise, and across them rough planks of oak, which were fixed in their place by long wooden pins driven through holes at each end. From the photograph the wood appears to have been well preserved, but having been covered up again shortly after the excavation was made, I can give no further details of its condition. In the same place was discovered a sort of raft or flat-bottomed boat, 40 feet long and 6 feet wide, which was also covered up again. From the illustration given, this seems to have been made of five logs placed side by side, and held together by cross ties passing through holes in projections on the upper side of the logs.

In the foundations of Winchester Cathedral, oak piles had been used to form a solid foundation in the wet peaty soil on which part of the structure rested. When the Cathedral was under restoration in 1906, samples of these piles sent me by Mr. Jackson, the architect of the work, who said that they were put down in the time of William Rufus, were in places decayed. Some logs of beech laid horizontally under the same building, which Mr. Jackson attributes to Bishop de Lucy, about A.D. 1206, remained comparatively sound, and, though the wood has changed from its natural colour to a grey, is fit to use as boards for bookbinding.

With regard to the foundations of the Campanile at Venice, it has been stated that they were laid on larch piles, which are still used in that city for the same purpose; but when I was at Venice in 1905 I inquired into this, and was given a section of an oak pile only about 6 inches in diameter, but perfectly sound and very hard, which was cut from one of the piles taken from the foundation of the Campanile after it fell. (H. J. E.)

LARIX

Larix, Adanson, *Fam. Pl.* ii. 480 (1763); Bentham et Hooker, *Gen. Pl.* iii. 442 (1880); Masters, *Journ. Linn. Soc.* (*Bot.*) xxx. 31 (1893).
Pinus, Linnæus, *Gen. Pl.* 293 (in part) (1737).
Abies, A. L. de Jussieu, *Gen.* 414 (in part) (1789).

Trees belonging to the order Coniferæ, with thick scaly bark, irregular and not whorled branches, and deciduous foliage. Branchlets of two kinds, long shoots bearing solitary leaves spirally arranged, and short shoots bearing numerous leaves in tufts at their extremities, these leaves being of unequal lengths and arising each in the axil of a bud-scale. Leaves linear, either flattened or keeled above, always strongly keeled beneath, with a single fibro-vascular bundle and two resin-canals close to the epidermis of the outer angles. Buds of three kinds: (1) terminal on the long branchlets and developing either into long or short shoots; (2) axillary on the long branchlets, scattered, solitary in the axils of the leaves, and developing occasionally into long shoots, or more commonly producing short shoots with apical tufts of leaves; and (3) apical buds on the short shoots, which usually on developing slightly prolong the short shoot and produce again a tuft of leaves, this process being repeated for several years; or occasionally suddenly elongate into long shoots with solitary leaves, or produce flowers. In this way a complicated and irregular system of branching results, very different from that produced by the regular whorled buds of pines, silver firs, and spruces.

Flowers monœcious, fertilised by the wind, arising solitary on the apices of short shoots of two to six years old. Male flowers always much more numerous than the females, directed downwards; globose, ovoid or oblong; sessile or stalked, surrounded at the base by scales, and composed of numerous stamens with short stalks spirally arranged on a central axis; anthers two-celled, dehiscing longitudinally; connective rounded. Female flowers always erect, subglobose, girt at the base by a bundle of leaves, and consisting of a series of orbicular, stalked, ovular scales, each in the axil of a much longer mucronate, oblong bract. The scales, each bearing two ovules, increase in size, as the flower develops into the fruit, while the bracts do not increase.

Fruit a cone, short-stalked and always erect, composed of concave imbricated woody scales, which are persistent and are either longer or shorter than the bracts; cones ripening at the end of the first season, the scales opening and letting out the seeds, which are distributed by the wind in autumn or in the following spring, the empty cones remaining on the branches for several years. Seeds, two on each scale, with a translucent wing, which remains coalesced with the seed, covering it entirely on the upper side, and extending for some distance along its outer edge.

The genus is confined to the temperate and colder regions of the northern hemisphere, and comprises about fourteen described species. Four of these, which we have not seen either growing wild or in cultivation, will now be briefly alluded to.

Larix Cajanderi, Mayr, *Fremdländ. Wald- u. Parkbäume*, 297, fig. 88 (1906). Discovered by Dr. Cajander in eastern Siberia, where it occurs along the banks of the river Lena from the mouth of the Aldan at 68° N. lat. northwards to 72° N. lat., becoming here a stunted tree only 10 to 20 feet in height. It usually forms mixed woods with the Siberian spruce or *Betula odorata*, assuming in wet soil the same appearance as is presented by *L. americana* in the swamps of Wisconsin; or on unflooded land growing pure to a height of about 70 feet. Judging from the description it is closely allied to, if not a mere variety of, *L. dahurica*. The young branchlets are yellowish brown with scattered hairs, older branchlets becoming ashy grey. The leaves are very long, up to 2 inches in length; and are accompanied on the opening of the bud by a tuft of dense whitish pubescence, which is absent in *L. dahurica*. The cones are small, with about twenty scales, which gape widely when ripe, and are broad and concave on the upper margin.

Larix Principis Rupprechtii, Mayr, *op. cit.* 309, figs. 87, 94, 95 (1906). This species was discovered by Mayr on the Wu Tai mountain in the province of Shansi in northern China; and appears to resemble strongly the European larch, from which it differs in the cone-scales being finely denticulate and glabrous, with bracts short and only visible towards the base of the cone. This species has been introduced into Europe by Mayr, who brought a living plant to Grafrath, near Munich, which is growing there very vigorously.

Larix kamtschatika, Carrière, *Conif.* 279 (1855); *Abies kamtschatika*, Ruprecht, *Beit. Pflanzenkund. Russ. Reich.* ii. 57; *Pinus kamtschatika*, Endlicher, *Conif.* 135 (1847). This species, which occurs in Kamtschatka, is said to differ from *L. dahurica* in having larger cones. It is imperfectly known, and has not been introduced.

Larix chinensis, Beissner, *Mitteil. Deutsch. Dendrol. Gesell.* 1896, p. 68, and 1901, p. 76; and *Nuov. Giorn. Bot. Ital.* iv. 183, t. 5 (1897). A tree, dimensions of which are not stated. Branchlets yellow, glabrous. Leaves up to 1¼ inch long, triangular in section, stomatose on the under surface. Cones ovoid-cylindrical, 1½ to 2 inches long; scales numerous, orbicular, entire, coriaceous, furrowed and tomentose on the outer surface, standing horizontally in the opened cones; bracts lanceolate, truncate at the narrowed apex, with a short mucro, extending considerably beyond the upper margin of the scale, and appressed and not recurved in the unripe cone. Seeds about ⅙ inch in length with a broad wing slightly exceeding the seeds in length.

This species, specimens of which I have recently seen in the Museum at Florence, was discovered at 10,000 feet altitude in the Peling mountains of Shensi in China by Père Giraldi in 1893. Beissner has raised seedlings from seeds sent in

1899, and some of these have been grafted on the common larch and are now growing in the Arnold Arboretum, Massachusetts.

This larch in botanical characters stands nearest to *L. occidentalis*. Occurring at a high elevation in Shensi at about lat. 38°, it should prove perfectly hardy in this country; but must not be expected to be of much importance as a forest tree.

The remaining species, ten in number, are tolerably well known, and are readily distinguishable by the characters of the cones and flowers. In the absence of cones, the following arrangement will give a good clue to the species :—

A. *Leaves deeply keeled on both surfaces.*

1. *Larix Lyallii*, Parlatore. Western N. America.
   Young branchlets completely covered with a dense greyish tomentum, which persists in part in the second year.
2. *Larix Potanini*, Batalin. Western China.
   Young branchlets bright yellow in colour, with a scattered pubescence.

B. *Leaves keeled only on the lower surface, the upper surface being flattened or rounded.*

* *Young branchlets pubescent.*

† *Leaves glaucous, bluish, with two conspicuous bands of stomata, each of five lines, on the lower surface.*

3. *Larix leptolepis*, Endlicher. Japan.
   Branchlets of the second year reddish, with a glaucous tinge. Leaves numerous in the bundle, at least forty, long and slender, arranged in an erect cone-like pencil.
4. *Larix kurilensis*, Mayr. Kurile Islands.
   Branchlets of the second year shining reddish brown, pubescent, not glaucous. Leaves few in the bundle, often only twenty to thirty, short and very broad, spreading so as to form an open cup around the bud.

†† *Leaves greenish, with two inconspicuous bands of stomata, each of two to three lines, on the lower surface.*

5. *Larix Griffithii*, Hooker. Himalayas.
   Branchlets of the second year very stout, dull reddish brown, pubescent. Short shoots broad and fringed above by very large loose reflected pubescent membranous bud-scales.
6. *Larix occidentalis*, Nuttall. Western N. America.
   Branchlets of the second year slender, light brown, shining, pubescent. Short shoots slender, with narrow inconspicuous fringe of bud-scales.
7. *Larix sibirica*, Ledebour. Russia, Siberia.
   Branchlets of the second year slender, shining, greyish yellow, glabrous, the long hairs present in the furrows between the pulvini of the first year's shoot having fallen off. Leaves very long and slender, up to 2 inches in length.

** *Young branchlets glabrous.*

† *Branchlets yellowish grey in colour.*

8. *Larix europæa*, De Candolle. Europe.

Branchlets of the second year shining, glabrous, yellowish grey.

8A. *Larix sibirica*, Ledebour, *var.* Russia.

In certain specimens of this species the branchlets are indistinguishable from those of *Larix europæa*, and in the absence of cones only show a difference in the leaves, which are very long and slender in *L. sibirica*.

†† *Branchlets brown in colour.*

9. *Larix americana*, Michaux. North America.

Young branchlets often glaucous. Branchlets of the second year shining brown. Short shoots blackish. Leaves short, not exceeding 1¼ inch in length.

10. *Larix dahurica*, Turczaninow. Siberia.

Young branchlets never glaucous. Branchlets of the second year shining brown. Short shoots blackish. Leaves long, exceeding 1¼ inch.

These two species strongly resemble each other in technical characters, but are readily distinguished, as seen in cultivation in this country, by the appearance of the branchlets, which in *L. dahurica* are vigorous, long, and straight, whereas in *L. americana*, which makes slow growth, they are short, curved, and twisted.

10A. *Larix occidentalis*, Nuttall, *var.* In glabrous specimens of this species the chestnut-brown coloured short shoots will readily distinguish them from either of the two preceding species.

Mayr says that though the various species of larch seem very different at the first sight, yet that they all have the same biological character, and are all inhabitants of the coldest limits of the forest, whether produced by latitude or altitude, and that when introduced into warmer regions or zones, they lose their economic usefulness through premature fruitfulness or fungoid attacks. This opinion, though so often expressed in various forms by foresters of continental experience, is not strictly applicable to Great Britain, as the pages of this work will prove; and though the liability to spring frost is greater with the more northern and alpine species, yet in their native countries larches are also subject to frosts during almost every month in the year, and though the young shoots in spring and the unripened wood in autumn are often much injured by frost, yet no trees have a greater power of recovering from injuries produced by climatic influences, provided the soil is suitable; and Mayr truly says that the warmer the climate in which the larch is cultivated the better the soil it requires. He considers that the timber of all larches is practically of equal value, its quality depending on the slowness at which it is grown, rather than on the species or origin of the parent tree.

LARIX EUROPÆA, Common Larch

Larix europæa, De Candolle[1] in Lamarck, *Fl. Franç.* 3rd ed. iii. 277 (1805); Loudon, *Arb. et Frut. Brit.* iv. 2350 (1838); Willkomm, *Forstliche Flora*, 140 (1887); Mathieu, *Flore Forestière*, 555 (1897); Kent, *Veitch's Man. Coniferæ*, 391 (1900).
Larix decidua, Miller, *Dict.* ed. 8, No. 1 (1768); Kirchner, Loew, u. Schröter, *Lebengesch. Blütenpfl. Mitteleuropas*, 155 (1904).
Larix pyramidalis, Salisbury, *Trans. Linn. Soc.* viii. 314 (1807).
Larix vulgaris, Fischer, *ex* Spach, *Hist. Vég.* xi. 432 (1842).
Larix Larix, Karsten, *Pharm. Med. Bot.* 326 *f.* 157 (1882).
Pinus Larix, Linnæus, *Sp. Pl.* 1001 (1753).
Pinus læta, Salisbury, *Prod.* 399 (1796).
Abies Larix, Poiret in Lamarck, *Dict.* vi. 511 (1804).

A tree attaining 100 to 150 feet in height[2] and 10 to 15 feet in girth. Bark of young stems and branches smooth and grey; on older stems (twenty years and upwards) fissuring and scaling off in thin irregular plates, exposing the reddish cortex below; at the base of old trunks in the Alps becoming extraordinarily thick, a foot or more. Young branchlets slender, glabrous, greyish yellow, with linear pulvini separated by narrow grooves; in the second and third year shining yellow with more elevated pulvini, at the apices of which are the scars of the fallen solitary leaves; base of the shoot girt by a sheath of the bud-scales of the previous season, within which is visible a ring of pubescence. Short shoots dark brown, with rings of pubescence marking each year's growth. Terminal buds small, globose, resinous, with glabrous scales, the lowermost of which are subulately pointed. Lateral buds hemispherical, glabrous, broadly conical, surrounded at the base by a dense ring of hairs.

Leaves light green, soft in texture; those solitary on the long shoots shorter, broader, and more acuminate than those in the tufts, the latter differing in length, the longest about 1½ inch long, and rounded at the apex; upper surface flat or rounded, with one line of stomata on each side; lower surface deeply keeled, with two to three lines of stomata on each side.

Male flowers sessile, ovoid, ⅕ to ⅖ inch long. Pistillate flowers, reddish or occasionally whitish, ovoid, about ½ inch long; bracts, with their mucronate apices pointing upwards and outwards and not reflected or recurved, about ¼ inch long, oblong, widest at the base, deeply notched above between two pointed projections; mucro about 1/12 inch long.

Cones ovoid, with the tips of the bracts slightly exserted, 1¼ to 1½ inch long,[3] the terminal scales small and not gaping but closing the rounded or flattened apex of the cone. Scales in four to five spiral rows, nine to ten scales in each row, about ½ inch broad and long, convex from side to side but flattened longitudinally, with the apex usually retuse, often emarginate or rounded; margin thin, entire, not bevelled, and neither inflexed nor recurved; outer surface light brown pubescent, the pubescence most marked towards the base. Bracts oblong, widest at the base, truncate or rounded at the apex, with a short mucro extending about half-way up the scale. Seeds in shallow depressions on the scale, with wings narrowly divergent and extending almost quite to its upper and outer margin; body of the seed ⅙ inch long, wing short and broad, widest near the base; seed with wing less than ½ inch long; wing ⅙ inch broad.

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[1] We adopt the name *Larix europæa*, although it is not the oldest one, because it has been in general use for over a century. According to a note at Kew of Alph. de Candolle the *Flore Française*, 3rd ed., was published in reality in 1805, and not in 1815, as it is printed in the volume at Kew.

[2] Kerner, *Nat. Hist. Plants*, Eng. trans., i. 722 (1898), gives the greatest certified height of the larch as 53.7 metres, equal to 176 feet; and this refers to a tree growing in Silesia, mentioned by Mathieu, *loc. cit.* 556.

[3] In the Museum at Florence there are specimens from Courmeyeur, in the Piedmontese Alps, with cones two inches in length, the largest which I have seen, and remarkable for the dense velvety pubescence of their scales.

VARIETIES

The flowers of the common larch are occasionally white in colour.[1] This occurs both in the wild state and in cultivated trees, as at Arley Castle.

Various kinds of weeping larch have been found wild or have originated in cultivation: and some have been propagated by grafting. *Var. pendula*, Lawson, is noted by Loudon, who states that there were large trees of this kind at Dunkeld, which had been raised from Tyrolese seed. In this form there is an erect leader, and the branches are spreading or even ascending, the branchlets being very slender, elongated, and quite pendulous. In another form of weeping larch the habit is quite different, as it has no tendency to form an erect leader, the trunk remaining short and often divided near the top into several secondary stems that are bent downwards, as are the branches and branchlets. A remarkable example[2] of the latter form, with extremely long slender pendulous branchlets, was growing in 1888 in Mr. Maurice Young's nursery at Milford. *Var. pendulina*,[3] Regel, *Gartenflora*, 1871, p. 101, does not seem to be essentially different in habit from this. Loudon[4] mentions a remarkable pendulous larch at Henham Hall, Suffolk, which was planted in 1800, and was supported on pillars, the main branches forming a covered alley 80 feet long and 16 feet wide in 1841. I am informed by Mr. Simpson, gardener at Henham Hall, that this tree is now in good health, the tall shrubs which surrounded it having been cleared away on one side some three years ago, since when it has made surprising growth. At three feet from the ground it measures 8 feet 2 inches in girth, and at about eight feet forms an angle, and extends laterally for a great distance, being supported on pillars and cross pieces which form a pergola 140 feet long, 8 feet high, and 10 to 14 feet wide, which is almost completely covered by its branches, and will shortly require extension. In a note at Kew, dated 1882, Sir J. Hooker mentions a weeping European larch at Waterer's nursery, Bagshot, which was 50 feet high and had the habit of *Larix Griffithii.*

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[1] Referred to in *London Catalogue of Trees*, 43 (1730).

[2] Well figured in *Gard. Chron.* iii. 430, 531, Supplementary Illustration (1888). Var. *pendula*, Lawson, is figured in *Gard. Chron.* ii. 684, fig. 132 (1887).

[3] Cf. Beissner, *Nadelholzkunde*, 325, fig. 89 (1891).

[4] *Gard. Mag.* 1841, p. 353. Another weeping larch is figured in the same journal, 1839, p. 574.

DISTRIBUTION

The most recent account of the distribution of the European larch is by Cieslar,[1] the distinguished Austrian forester, who points out that the tree in the wild state occupies four distinct and separate regions, namely, the Alps, the Silesia-Moravia boundary, Russian Poland, and the Tatra mountains in the Carpathians. Cieslar strongly disputes the commonly accepted view that the larch is everywhere an alpine tree, occurring at high elevations; and holds that the Silesian and Alpine larches are two distinct climatic varieties, differing in habit and mode of growth, in period of vegetation and in the altitude at which they naturally grow. He has not apparently studied the Polish tree, of which I have seen no specimens, nor the Carpathian larch.

In the Alps, the larch is widely distributed, occurring in French territory in Savoy, Provence, and Dauphiné; and in the Maritime Alps it reaches about 44° 30′ N. lat., its most southerly and at the same time its most westerly limit. In Switzerland the larch, while generally found, does not occur in the Jura and in the cantons of Glarus, Schwyz, Upper and Lower Unterwald; it reaches its most northerly point in Switzerland on the Gäbris in Appenzell. Extending eastwards it occurs in Vorarlberg, in the Alps of Bavaria and Salzburg, in the Tyrol and in Carinthia. According to Cieslar it is wild in the provinces of Upper and Lower Austria only south of the Danube, but is found near Vienna as a planted tree. It is absent from lower Styria and nearly the whole of the Karst; and in Carniola does not occur wild south of the Sannthaler Alps; from Idria the southern limit of distribution runs westward into Italy through the Isonzo valley. In Italy the larch is confined strictly to the Alps and is not wild in the Apennines, where it has been occasionally planted with unfavourable results, as the tree, after growing rapidly for twenty years, slackens in growth and becomes decrepit at 40 to 45 years old.[2] Elwes saw it planted in the Sila mountains of Calabria, where it was producing seed at 10 to 15 years old.

In the Alps the larch is certainly an alpine tree, often reaching the timber line in company with *Pinus Cembra* and *Pinus montana*; while lower down, but above the zone of the beech, it is usually met with either pure or in company with the spruce and silver fir. It occurs, mixed with the beech, at low elevations, according to Cieslar in certain valleys of the Tyrol. M. Coaz,[3] Inspector-General of Forests of Switzerland, is of opinion that the forests of pure larch which now exist in the Alps are not natural, but have been produced artificially by cutting the ancient mixed woods. The larch has taken possession of the felled areas and has succeeded well as regards growth; but the pure forests are liable to insect attack and possibly also to disease; so that he thinks that it is necessary to restore artificially the ancient and natural condition of the forest. The highest elevation recorded for the larch is 8200 feet in the Dauphiné. The upper limit in the Central

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[1] *Waldbauliche Studien über die Lärche*, 4 (1904).

[2] Borzi, *Flora Forestale Italiana*, 25 (1879).

[3] See *Garden and Forest*, 1895, p. 238, for a résumé of M. Coaz's monograph on "Insect Ravages in the Forests of Larch on the High Alps."

Alps varies from 6500 to 8000 feet, and in the Engadine is 7622 feet; on Mont Blanc 7218 feet; at Zermatt 7874 feet; in Northern Switzerland, Salzburg, and the Bavarian Alps, 6400 feet; in the Venetian Alps 6700 feet. The lower limit to which the larch descends in the Alps is 1400 feet at Martigny, 2300 feet at Castasegna, 2000 feet at Chur, 3000 feet in the Bavarian Alps, 2000 to 2300 feet in the South Tyrol, 1300 feet in Lower Carinthia, and 1600 feet in Lower Austria.

The Larch occupies on the boundary between Silesia and Moravia a small area, about 30 German square miles, lying between the rivers Mohra and Oppa, and occupying a zone on the mountains between 1170 and 2840 feet elevation; but only occurring in a very scattered condition above 2600 feet. It grows here in mixture with spruce, silver fir, and beech; and appears to be indifferent to soil, as it is met with on primitive schists, grauwacke, and basalt: it occurs also on all aspects. It is absent from the adjacent high mountain of Altvater, which rises to 4900 feet, and is clothed with spruce and mountain ash. According to Cieslar, the Alpine larch has been unadvisedly introduced into Silesia, and it will be difficult in the future to obtain pure seed of the Silesian variety. Cieslar considers this form to be entirely distinct from the larch of the Alps, as it has a cylindrical stem, with slender branches and twigs which are directed upwards, and form a very narrow slender crown. The Alpine larch has stouter branches and twigs, which are directed horizontally, and form a much more spreading crown of foliage, the stem being much more tapering. Introduced into cultivation at low elevations, the Silesian larch is later to come into leaf, and sheds its leaves earlier in autumn, grows much faster, is less liable to damage from snow, and can, on account of its narrow pyramidal form, be planted much more densely. The Alpine larch will not bear crowding, according to Cieslar, and is an inferior tree for planting in every respect.

In Russian Poland, the larch is mainly met with on the hilly land of Lysa Gora, where it forms large forests on sandy soil between Konskie and Szydlowice, near Samsonow. It also extends over the right bank of the Weichsel into Galicia. According to Vrzozowski, the larch at one time was spread over the governments of Piotrkow and Warsaw, as churches and manor houses built 300 to 500 years ago of larch wood are still standing. The distribution of the larch in ancient times must also have extended considerably to the eastward, as a church built of larch in 1419 is reported to exist at Slucz in the government of Minsk in West Russia. Count Dzieduszycki's forester at Poturzyca, near Sokal, in Galicia, reports that larch occurs there between 600 and 800 feet elevation.

The larch occurs also, but not extensively, in the Tatra mountains, between Hungary and Galicia, where it grows on southwest slopes up to 5200 feet, reaching a somewhat higher altitude than the spruce and not ascending as high as the Cembra pine. Cieslar finds no reliable evidence for the larch being wild in the Carpathians east of the Tatra mountains; and does not credit its occurrence in Transylvania.

Prof. Huffel[1] of Nancy states that the larch occurs, but is very rare, in Roumania, where he saw it in the mountains which separate the valleys of the Ialomitza and Prahova at 6300 to 6600 feet elevation, Here it was growing either in mixture

[1] *Forêts de la Roumanie*, 6.

with the spruce or higher than it. In Moldavia he reports it on the Ceahlaŭ, where it rises on a southern slope to 5550 feet. The larch in Moldavia and Roumania has been considered to be *Larix sibirica*; but Huffel doubts this.

Herr F. Mack, forest administrator at Azuga in Roumania, states[1] that larch is common at Bucecii above the beech region, at from 1300 to 1600 metres, mixed with spruce. It attains 60 to 65 centimetres, or about 2 feet in diameter, and is often clear of branches to a considerable height. The wood is hard, red, and durable, and was used in the construction of the Royal Palace of Sinaia.

INTRODUCTION

There is little doubt that the larch was introduced into England about the beginning of the seventeenth century, as Parkinson, who published his *Paradisus* in 1629, speaks of the tree as rare. Evelyn,[2] writing in 1664, mentions "a tree of good stature not long since to be seen about Chelmsford in Essex," and urged its cultivation as a useful timber tree. The earliest trees in Scotland are supposed to be those at Dunkeld, the history of which is given below; but we have no reliable evidence as to the exact date and locality where it was first planted. Loudon's account is very full and should be consulted. The very useful little book by C. Y. Michie on the larch, published in 1885 by Blackwood, must not be overlooked, as it gives a very good résumé by a practical forester whose experience in Scotland was considerable. A. H.

PROPAGATION

Ever since it was realised by landowners that the larch was the tree which before all others could be looked on as profitable to plant, its propagation has been one of the most important branches of the nurseryman's business, especially in Scotland, where by far the larger part of the trees grown in England are raised; and until the disease spread all over the country, and it became evident that precautions must be taken, which in the palmy days of larch-growing were not considered necessary, the majority of raisers were not very careful as to the source from which their supplies of seed were obtained. It was generally supposed that Scottish seed was best, though in years when it could not be obtained in sufficient quantity foreign seed was used.

So far as I have been able to ascertain from very numerous inquiries, the reason for this idea was, that foreign seed usually germinated more quickly, and that the seedlings were therefore more liable to be killed by severe spring frost just as they were germinating. But as all the old larches in England and Scotland must necessarily have been raised from foreign seed, it seems obvious that though Scottish seedlings may have been most profitable to the nurseryman, yet that unless the seed was gathered from carefully selected trees, they were liable in after-life to show weakness of constitution, and succumb, as they often did, to the attacks of *Peziza Willkommii*.

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[1] *Zeit. für Forst. und Jagdwesen*, Oct. 1904, p. 644.

[2] *Silva*, Hunter's ed., 1776, p. 297.

Another reason has been assigned, with some probability, to the apparently greater liability to disease of larch now than formerly, namely, that the cones are often gathered too early, and exposed to too much heat in the kilns in order to extract them. The cone of the larch does not open of its own accord usually until spring; often in this climate so late that the seedlings make little growth the first year, and the seed cannot be extracted without heat, or by breaking up the cones in a mill, which bruises and destroys many seeds; and in the climate of Scotland they do not often ripen so early or thoroughly as in the drier, colder, and sunnier climate of its native Alps: therefore it seemed to me desirable to make experiments with larch seed from abroad, in order to find out whether there was any real difference in the vigour of foreign and home-grown seedlings; and though my experience in this way now extends over fifteen years, I cannot say that I have solved the question.

On many occasions I have sown seed from Scotland, the French Alps, and the Tyrol, and have found that on my poor calcareous soil, which, though it grows larch very well, is not at all suitable for raising it, a large proportion of these seedlings from all sources either perished in infancy, or grew so slowly in the first two years that they were far inferior to seedlings raised in Scotland on a better soil and climate, and probably on manured land. But many of these weaklings have afterwards grown into robust young trees, and the difference in their liability to suffer from spring frost, which is their greatest enemy, is not sufficiently marked to enable me to form a sound opinion as to which are best.

What I have learnt, however, is that, though seedlings cannot be raised as cheaply or as rapidly at Colesborne as in a Scotch nursery, they are more satisfactory in other ways, because it is better to eliminate the weaklings before they are planted out than to have to replant them afterwards; and I believe that the greater the risk of disease the more careful one must be, not only in the selection of seed, but also in their nursery management. Another point in favour of home raising is that the seedlings are not exposed in their younger stages to the extreme drying of the roots which arises from the careless way in which they are often lifted and packed by nurserymen, and from the long delays in transit on the railway; and, finally, the transplantation in a private nursery is more carefully done, and the roots are better developed and more able to endure the severe check of final transplantation to a soil which is less favourable to their growth than that of the nursery.

Mr. J. P. Robertson, forester to the Duke of Devonshire at Chatsworth, writes me as follows with regard to the comparative hardiness of larch raised from native and foreign seed in 1903:—

"We have two nurseries, one at an elevation of 900 feet, the other at about 600. In both a large quantity of larch from home seed have been put in this spring, while in each a break of the Tyrolese, 10,000 in number of similar size, has been placed. These last were from two different nurserymen. In both nurseries the home variety has suffered severely from the strong white frosts that we had in Easter week, while the Tyrolese in each case is practically untouched."

But on inquiry in 1905 whether this apparent superiority was still the case, he wrote:—

"I did not require to wait long to see the results reversed, as severe frosts in June of that same year, I think on 21st, 22nd, and 23rd, when we had 9°, 10°, and 8° of frost respectively, nearly put the Tyrolese bed out of existence, while those that had been cut earlier in the season (the home variety) did not suffer to anything like the same extent. I am now so thoroughly convinced in my own mind of the superiority of larch from home or British seed, that I have entirely discarded the Tyrolese."

Though the seed is ripened in ordinary seasons in all parts of the country, and a few self-sown trees may be found on most estates where rabbits are kept down, yet our conditions of soil and climate are so unlike those of the natural larch forests of the Alps, that it is useless to attempt natural reproduction with any economic advantage. The only cases in which I have seen any number of self-sown seedlings in the southern half of England are where a clean felling has been made of the larch, and the ground more or less broken up by hauling out the logs immediately afterwards. Of the seedlings which germinate, so large a proportion are destroyed by frost, drought, or vermin in the first season, that the number remaining is not worth consideration, and their growth is so slow for five or six years that planted trees of half the age will usually be stronger. On sandy land, however, or at high elevations, and especially in Scotland, it may sometimes be worth while to encourage self-sown trees, but I cannot say that I have ever seen even a small area which is either sufficiently or regularly stocked by self-sown larch.[1] In the Alps, on the other hand, where the soil is covered with snow for three months or more, natural regeneration is both easy and regular, and I have, both in the French and Italian Alps, seen the ground covered with larch seedlings, which, taken up as late as May, when just uncovered by the snow, I have brought to England when a few inches high, with success. Indeed, it is wonderful how long seedlings will live if taken up when vegetation is just commencing, and sent by post in small tin boxes, tightly packed with a little damp moss or soil, and such trees are my most agreeable souvenirs of many visits to distant countries.

The manner in which the seed is collected in the French Alps is described to me as follows by M. Surel, Inspector of Forests at Briançon, a district which is celebrated for its larch forests:—"In February, before the season when the cones are ripe, we choose trees of which the cones are still closed, and spread large cloths round their trunks at about 10 feet from their base. When the cones open, the seed falls on the cloths. It is then dried in the sun, or preferably, in order to avoid excessive drying, under an open shed. The collection takes place at a minimum altitude of 5500 feet, where the snow is still frozen, and the drying of the seed by the sun, which in this district is remarkably strong, the thermometer rising in the sun in February to 30° to 32° Centigrade, is therefore carried on under very favourable conditions. Drying by the stove would give deplorable results. If I were obliged to work in a climate where the climatic conditions made our practice impossible, I should use closed rooms, slightly heated, but of which the air was freed from moisture by chloride of calcium."

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[1] Prof. Fisher tells me that on old roads, and other places where the soil has been exposed, on the shores of Lake Vyrnwy in Wales, and also on old pit banks in Dean Forest, he has seen numerous self-sown larches spring up.

I was informed by M. Mougin, Conservator of Forests at Chambery, that in the Modane district the cones are collected at the end of November by men who climb the trees, with a long hooked pole, and gather the cones by hand into a bag which they carry. The cones are received twice a week at the drying-place, where they are spread out in an airy shed, and turned over every day to dry them and prevent them from heating. When the fine weather returns, they are spread out on a cemented floor, exposed to the sun, which opens them, after which the seed is collected and cleaned, and put in boxes, which are shaken frequently to prevent the attacks of insects. Sometimes seed can be collected on the snow under the trees in January by shaking the trees. But in no case is a stove used to extract them, as seems to be the usual practice in Scotland.[1]

From Prof. A. Fron,[2] of the Forestry School of Les Barres, I have received valuable information on the germination of larch seed, which I summarise as follows: He considers that the process usually adopted of grinding the cones in a mill is very inferior to either of those which I have described as in vogue in the Alps, because the seeds of good quality which come from the central portion of the cone are mixed with those from its upper and lower ends, which are usually empty or imperfect. In 1905 he made experiments on the germination of larch seed obtained at Modane, which had been extracted by the heat of the sun, and obtained the following result:—

Purity	98 per cent.
Germinative power	61.3 ,,
Cultural value	60.1 ,,

whilst the average of the seeds obtained from seedsmen only gave the following result:—

Purity	80 to 85 per cent.
Germinative power	45 ,, 50 ,,
Cultural value . . .	40 ,,

I may say that the seeds I have gathered from my own trees late in March, and extracted by exposing them to the sun under glass in a garden frame, have germinated quicker and grown better than any which I have purchased.

An ideal way of raising larch would be as follows: To gather cones in the month of March or April from the best and healthiest mature trees in one's own district, or, failing this, from trees known to be healthy on a similar soil; or to purchase seed of known origin direct from a reliable firm abroad, among whom I can highly recommend Messrs. Vilmorin of Paris and Messrs. Jenewein of Innsbruck.

The seed-bed should be in an elevated position, where spring frosts are not likely to be severe, and sheltered as much as possible from the morning sun by trees or by clipped hedges or high walls. The soil, light and friable, and, if naturally poor, enriched by manuring with leaf mould and road scrapings, and as free from weed seeds as possible, should be laid up into beds 4 feet wide, with perfect drainage, in the previous autumn, so as to have a fine mould on the surface.

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[1] Prof. Fisher tells me that in Germany larch seed is extracted from the cones by a toothed axis rotating in a drum, also lined with shorter teeth, and driven by water or steam power.

[2] For further particulars concerning the purity and germinative power of larch seed from different sources, cf. Fron, *Analyse et Contrôle des Semences Forestières*, 92 (1906).

About the middle of April, but earlier or later according to the climate, the seed should be steeped in warm water for a day or two and dusted with red lead when damp, in order to keep mice and birds from attacking it.[1]

On a dry day the seed should be sown broadcast as evenly as possible, and thick enough to have about one plant to the square inch, or less if the seedlings are to remain two years before transplanting. If the soil becomes dry the beds must be watered and shaded as the seed begins to germinate, which should be in fourteen to twenty days after sowing. At this time great care must be taken to prevent the seedlings from damping off, and it is better to keep the bed rather dry than wet. If weeds appear they must be carefully pulled up when quite small. If the soil and season are favourable the seedlings will in the first season be 4 to 6 inches high. If they should be too thick to stand a second season in the seed-bed, the strongest should be lifted and pricked off in lines about the end of March in the second year, and if there is much risk of a severe frost it is wise to transplant them all, as this check will retard their too early growth.

After transplanting they should remain two years in the nursery lines, except in the case of strong one-year seedlings, which may be fit to plant out one year after transplanting, but this must depend on the soil and the nature of the ground where they are to be planted out. Except for planting in woods or in places overgrown with coarse grass or fern, seedlings of one year old plus two years transplanted, or two years old plus one year transplanted, are, in my experience, large enough; and any which, from overcrowding or other causes, are not then strong enough may be rejected and have another year or two in the nursery. There will always be a considerable proportion of young trees which are inferior to the rest in size and vigour, and these are better separated when transplanting; whilst all those whose leaders are frosted or immature should be rejected, no more than forty to fifty per cent of the whole being usually fit to plant out at three years old.

The raising of such trees may cost from 20s. to 30s. per thousand in a private nursery, and though they can often be bought cheaper are, in my opinion, worth the extra cost.

Mr. Robertson writes on the same subject as follows:—

"Here we are now, I am glad to say, as little troubled with larch disease as most people, and the reason is simply that we endeavour to keep the plants strong and healthy *at all stages of their growth*, so as to be better able to resist attack. It must not be forgotten in these days of continental forestry that larch is a light-demanding tree, and ought not to be grown on the same principle of density as advocated for shade-bearing species; but it is equally dangerous to over-thin, and thus bring about starvation, and consequently weakness, by cold winds."

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[1] It is a regular practice in some nurseries where large quantities of larch are raised from seed to soak it for a day or more in water, and then spread it out on a floor where it is daily turned over and sprinkled with water until it seems ready to germinate. By adopting this practice the germination is quicker and more regular.

CULTIVATION

Whether the system of notching or pitting is adopted must depend on the local conditions and the size of the trees to be planted. If not more than 18 inches to 2 feet in height, notching, when carefully done, is sometimes as successful as pitting, but in very dry summers a large proportion of the trees will die whichever way the planting is done. In my own experience allowance must be made, in calculating the cost of planting, for a loss of about 20 per cent on an average, though this is often much exceeded when the trees are planted after Christmas, or when their roots have become dry, or when careless workmen have been employed without very close and constant supervision. This is allowing nothing for damage done by hares and rabbits, which, unless thoroughly killed down before planting and kept out by a really effectual wire fence, will soon destroy a great many of the young trees.

Having once planted the trees, the success of the plantation will depend more on soil and climate than on the skill of the planter. For though larch will, owing to their extraordinary vigour, grow almost anywhere up to fifteen to twenty years old, they will not attain a large size unless the soil is moderately fertile and well drained and the situation open and airy. If large trees are desired, I should always advise a mixture of beech or birch being planted with them or three to four years later; but where the crop can be profitably realised as small poles, or where the soil and climate are really favourable for larch, they may be planted at four feet apart without mixture. The distance apart and the mixture of other trees can only be decided by local experience, the object in view being to keep the trees thick enough to suppress the grass without depriving them of enough light and air to keep their lateral branches alive until they are fifteen to twenty years old. All thinnings should be based on these considerations, and the poorer the soil the more distance is required between the trees to keep them growing. On my own soil I have repeatedly noticed that if grass already exists when the trees are planted, it is impossible to keep the larch thick enough to smother the grass, without crowding each other to the point of starvation and disease, and in such land a mixture of beech, at the rate of one beech to two or three larch, is essential. The result of this mixture is that the larch, instead of beginning to decay at forty to sixty years old, as it often does when on soil deficient in natural fertility, at which period it may be worth 5s. to 15s. per tree, will live and increase in girth till at least 100 years, when they may be worth from £1 to £3 or £4 each. After they have been cut the beech may remain, or if not thick enough to stand with advantage, the land will be left in a very much better condition for replanting than after a crop of pure larch.[1]

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[1] Prof. H. M. Ward gave in *Nature*, xxxvii. 207 (1887), the following account of an experiment conducted by Prof. Hartig:—"There is a plantation of larches at Freising, near Munich, with young beeches growing under the shade of the larches. The latter are seventy years old, and are excellent trees in every way. About twenty years

With regard to the probable profit arising from a crop of larch planted pure, and realised at 30 to 50 years as compared with a crop mixed with hardwood and realised at 80 to 100 years, I have, with the assistance of Sir Hugh Beevor and Dr. Schlich, made several calculations, but it depends so much on local conditions, on the price realised for thinnings, and on other circumstances which cannot be foreseen, that it seems impossible to estimate it with any certainty.

I have, however, arrived at the conclusion that the short rotation is, as a general rule, the more profitable, especially where a sporting rent varying from 2s. 6d. to 5s. per acre can be realised from pure larch plantations after the age of 15 to 20 years, when rabbits can be admitted freely without risk of serious damage, or where, as in many parts of Scotland, larch plantations are thrown open to sheep grazing.

What is undoubtedly the best system of forestry is not always the most profitable to the landowner, and every one must decide from his own experience which system will suit his own circumstances best.

When mixed with Spruce or Scots or Corsican pine, as is often done, the larch on suitable soil will usually far exceed the other conifers in value at the same age; and I see no advantage, but rather a loss in such a mixture.

In woods which have been treated as coppice-with-standards the larch is a more profitable tree than beech or oak, and may be introduced to the number of thirty to forty per acre immediately after each cutting of the coppice. If left till sixty to eighty years old there would thus be eventually about 100 trees per acre, which will pay much better in these times than the underwood; for if only ten trees, worth say 30s. each, be taken at each rotation, the value will amount to £15 per acre, and there are not many districts in England where underwood is now worth half as much. In Earl Bathurst's extensive woodlands near Cirencester this system has been adopted for many years with great success; but if rabbits exist it is necessary to protect each tree by a wire cage until it is old enough to be safe from their attacks, which it is in this district after twenty to thirty years of age.

The produce per acre of larch in plantations on really good land has in many instances been surprising, and so profitable to the owner that some writers have greatly exaggerated the average returns that may be expected. Prof. Charles E. Curtis,[1] assuming that 300 trees per acre may be grown to maturity, which I greatly doubt, states as a reasonable possibility of production for the larch, no less than 10,000 to 12,000 feet per acre, and says that it will be found possible to bring 1000 to 1200 poles per acre to a useful and profitable size in thirty to forty years. I have

ago these larches were deteriorating seriously, and were subsequently underplanted with beech, as foresters say, *i.e.* beech plants were introduced under the shade of the larches. The recovery of the latter is remarkable, and dates from the period when the underplanting was made. The explanation is based on the observation that the fallen beech-leaves keep the soil covered, and protect it from being warmed too early in the spring by the heat of the sun's rays. This delays the spring growth of the larches; their cambium is not awakened into renewed activity until three weeks or a month later than was previously the case, and hence they are not severely tried by the spring frosts, and the cambium is vigorously and continuously active from the first. But this is not all. The timber is much improved; the annual rings contain a smaller proportion of soft, light spring wood, and more of the desirable summer and autumn wood consisting of closely-packed, thick-walled elements. The explanation of this is that the spring growth is delayed until the weather and soil are warmer, and the young leaves in full activity; whence the cambium is better nourished from the first, and forms better tracheides throughout its whole active period."

[1] *Journ. Roy. Agr. Soc.* lxiv. 36 (1903).

never seen or heard of such an instance, and on writing to Prof. Curtis he could not tell me of anything at all near it.

The best estimate I have is from Sir Hugh Beevor of a plantation at Petworth belonging to Lord Leconfield. It is growing on a steep hill facing east, on sandy loam overlying sandstone, and at thirty-two years after planting contained about 300 trees or more per acre, averaging 15 feet each, which makes about 4500 feet per acre. At Mailscott Lodge, in High Meadow Wood, Forest of Dean, he saw a small plantation, thirty-four years planted, in which the trees on an area of half an acre numbered 214, averaging 9 feet per tree, equal to about 3800 feet per acre.

The best example on my own property is a plantation at Hilcot, now about fifty-four years old, in which there are 2500 trees on an area of about twenty acres. The trees average about 25 feet on the better parts of the land, and 10 to 15 feet on the worst, or about 18 feet over the whole area, equal to about 2200 feet per acre. There are some beech, wych elm, and other hard woods amongst them, which might make up a total of 3000 cubic feet per acre, and though the larch might stand ten to twenty years longer they are not now making a profitable increment.

Mr. J. E. Hellyar Stooke of Hereford sends me the following particulars of a sale in 1907, of larch sixty to seventy-five years old, growing on a hill 400 to 500 feet high, the soil being stiff clay overlying limestone facing east to south. There was no disease except on some of the smaller branches; the trees were all sound, and would probably have continued to grow for many years.

Lot.	Acreage.			Number of trees per acre.	Number of poles per acre.	Estimated contents per tree.	Estimated contents per pole.	Total estimated contents per acre.	Prices realised for larch on estimated contents.			
									Per cubic foot.	Per acre.		
	a.	*r.*	*p.*			cubic feet.	cubic feet.	cubic feet.	pence.	£	*s.*	*d.*
1	2	0	5	138.0	32.5	26.00	5.6	3769.6	8.89	139	18	0
2	2	2	18	134.7	54.3	26.27	6.26	3881.0	8.85	143	3	1
3	1	3	20	155.7	24.0	26.00	6.25	4197.8	9.01	157	14	8
	6	2	3									
Average of the above.				142.8	36.9	26.09	6.03	3949.4		146	18	7

These trees were sold standing, by auction, at such a distance from a railway station that the hauliers could only make one journey daily.

At what age it pays best to fell a crop of larch is a question which depends entirely on the growth of the trees and the local value: in some cases thirty to forty years may be the most profitable age, in most fifty to sixty; and where the trees are planted with a good mixture of beech, and continue to grow well after this period, it may pay to let them stand to 100 years old, beyond which they will seldom if ever continue to make a profitable increase.

I should say that £100 per acre was a very fair average valuation of a clean larch crop at forty to sixty years old, and though it is often exceeded, yet in many more instances I believe that at present prices the return will be less, even when disease has not seriously deteriorated the value of the trees by the scars and cankers which disfigure the trunks.

DISEASES OF THE LARCH

Though it is not within the scope of this work to describe the diseases of trees, yet an exception must be made in the case of the larch, because it is a subject of such vast economic importance that it may truly be said, that the losses of all other trees, from all kinds of diseases, whether induced by climatic causes, by insects, or by fungi, do not collectively approach the loss caused to English landowners by larch disease. In using this term without qualification I mean the disease caused by the fungus usually known as *Peziza Willkommii*, but which is now named by mycologists *Dasyscypha calycina*, and which is perhaps best described in English by the name "Canker," or "Blister." This began to attract attention in this country about 1859, when the Rev. M. T. Berkeley[1] made known its existence in England, and Charles M'Intosh in 1860 wrote a small book on larch disease, though what he described more especially was heart-rot, a very different thing from canker.

Hartig and de Bary were the first to describe the fungus. Prof. Marshall Ward in his *Timber and some of its Diseases*, published in 1889, described it more fully; and since then Mr. Carruthers, Dr. Somerville, and other scientific writers have written largely on the subject. In the *Gardeners' Chronicle*, 1896, are many interesting articles respecting the larch disease by J. S. W., Sir Charles Strickland, A. C. Forbes, and C. Y. Michie; and an excellent paper on it with coloured illustrations, by Mr. Geo. Massee, appeared in the *Journal of the Board of Agriculture* for September 1902.

The most practical observations on the larch disease I know of, are in Mr. A. C. Forbes's excellent work on *English Estate Forestry*, pp. 289-307 (1904). These should be studied carefully by every one who is in any degree interested in the subject. After giving a summary of the more important opinions and facts noticed in connection with this disease, he says—and I entirely agree with him—that the disease is as much the result as the cause of the bad health and unthrifty condition of many plantations throughout the country; and that the temporary debility which is induced by the conditions under which planting is conducted is largely responsible for a great deal of disease. He goes on to say that the practically permanent nature of the blister, when once established, renders the result of this temporary debility a much more serious matter than it otherwise would be. If the return to normal health and growth were accompanied by the disappearance of the disease, little harm would be done, but the existence of a blister, once established, is perpetuated indefinitely, and in most cases only ceases with that of its host, so that the occurrence of a blister on the stem of a young tree is much more serious than it would be on a branch or older stem. Cases commonly occur of the disappearance of the blisters when the trees recover health and vigour; and he mentions a plantation over twenty years old, more or less mixed with beech, on greensand, where a number of old blisters are gradually becoming occluded. That they were genuine blisters is evident from the remains of the Peziza cups still present, and the only possible theory respecting their disappearance must be found in the improved health of their host. I have frequently observed similar cases, both on my own land, where in some of the worst diseased plantations, individual trees, which on account of their greater vigour have taken a lead from the first, remain almost untouched and growing vigorously, when most of the surrounding trees are killed or severely injured; and also in Hertfordshire, where tall slender larch trees growing amongst beech showed at various points, from near the ground up to 50 or 60 feet, signs of repeated attacks, which had neither killed them nor apparently checked their growth materially. Forbes says that one may pick up dead twigs or branches under the largest, finest, and most isolated larches that can be found, and the fructifications of Peziza are invariably present on them. This fact he thinks is sufficient to prove that the mere existence of the fungus does not necessarily lead to diseased trees, using the term diseased in its practical sense.

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[1] *Gard. Chron.* 1859, p. 1015.

The year 1879 will long be remembered by all gardeners, farmers, and landowners in the southern half of England as the most disastrous in its effects on plants, farm crops, and trees generally. There was practically no summer, and the rainfall was so continuous, that in late districts much of the corn never ripened at all, and being followed by two severe winters, the disease spread to a degree which ruined hundreds of acres of young larch on my own estate, and caused a loss which must have amounted to millions of pounds throughout the whole country. Though after bad seasons and in smaller areas there had been disease before, it was generally assumed by planters that larch might be successfully grown on almost any kind of land without mixture, and without any special precautions, and there is little doubt in my mind that a large percentage of the worst cases originated in that season, and may be directly traced to the exceptionally bad climatic conditions which prevailed.

Mr. A. M'Dougal, forester to the Earl of Feversham at Helmsley in Yorkshire, who has charge of something like 10,000 acres of woodland, and, having been brought up on the Duke of Atholl's estate, has had unusual experience of the larch, tells me that in Yorkshire the disease first began to be prevalent about 1862 when two plantations died clean off. Since then it has been very prevalent on thin red loam overlying limestone rock; and this applies as much to localities which have previously been under oak wood, or cultivation, as to those where larch has been replanted after larch. He considers that severe spring frosts, together with low-lying situations and heavy soil, are the conditions which bring on the disease most severely.

Sir W. Thiselton Dyer, who has been good enough to read this article, does not quite agree with me with regard to the disease, which he considers due to physical causes alone, and not influenced by heredity. He says that the fungus is a wound parasite, whose spores can only develop in lesions where the bark is injured either by frost, weight of snow, insect punctures, or otherwise, and that it is usually worst in sheltered hollows, where damp air lies and spring frosts are severely felt, and that on high situations facing north and east the disease rarely causes much injury.

All this I admit in full, but I am also convinced that, as the spores of the fungus are now so generally present everywhere, it is impossible to eradicate it, the only way by which it can be combated is by planting only on soils and in situations which experience has shown enable the tree to grow vigorously, and on poor and dry soils mixing it with hardwoods, the fall of whose leaves enriches the soil and keeps it cool and free from grass.

Heart-Rot in Larch.—Though sometimes confused with Peziza by careless observers, this is a totally different disease. C. M'Intosh[1] describes it very fully, and Hartig refers to it under the name of root-rot. Forbes believes, as I do, that it is the direct result of unsuitable soil, either too wet or too dry. It is most common on very poor limestone, sand, and chalk, but also occurs on clay and gravelly soils. In my experience it is especially noticeable where larch follows larch on soils containing insufficient nourishment, and can only be avoided by not planting larch where it is found to be prevalent. It usually attacks trees of about twenty years old, when they have got over their first period of vigorous growth and have practically exhausted the available sources of nutrition. According to Mr. Simmonds, late Deputy Surveyor of Windsor Forest, larch grown on what is called iron pan in that district gets red rot at the heart and is then said to be "pumped."

Larch Bug.—What is commonly known as larch aphis or larch bug is an insect called *Chermes laricis.* The life-history of this insect is at present somewhat obscure, some continental observers believing that it passes through an intermediate stage of existence on the spruce, as no males have yet been found on the larch, in which case it is evident that the insect cannot spread or become numerous unless spruce exists in the neighbourhood. But this is contested by Dreyfus, and I have observed that in England at any rate it multiplies exceedingly where no spruce are near. The females pass the winter under the bark, and are wingless, oval, of a purplish-black colour, and have a long bristle-like sucker through which they feed on the sap of the leaves. In spring they lay eggs which produce young, which grow rapidly, and are covered later by a whitish woolly down, and when numerous give the trees a whitish appearance. They increase rapidly by successive broods, and seriously weaken the constitution of the trees when young, rendering them especially liable to succumb to the attacks of Peziza, which often accompany and succeed them. Whenever I have seen bad attacks of the bug I have noticed that the Peziza is more than usually destructive, and it seems as though the climatic conditions which favour the one also favour the other. In the autumn the bark of the trees in a badly attacked plantation appeared quite black; and though this plantation was in a high situation, exposed to the east, and was heavily thinned the year afterwards, the greater part of the trees, which were thirteen years planted from Tyrolese seed, and had been growing vigorously at first, were so sickly on the thinner and drier parts of the land that many will not survive. In the nursery I have observed that some trees were practically immune, though growing side by side with others whose branches touched them and were covered with the Chermes; but having marked these trees and watched them after they were planted out, I have not as yet been able to assure myself that this immunity is permanent. Though I have not found this insect attack Japanese, American, and Siberian larches at Colesborne as severely as the common species, yet I have seen it upon them all, both there and elsewhere. Blandford[1] says that washing the trees in April with a soft soap and paraffin mixture in hot water may prove effective, and suggests other forms of wash; yet it is evident that such remedies cannot be economically employed in plantations, and I know of no means of preventing the ravages of this insect; though thin planting, mixing with hardwoods, and the avoidance of thin dry soils and damp shady situations are undoubtedly the best means of avoiding severe injury from this pest, as well as Peziza.

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[1] *The Larch Disease* (1860).

Leaf-Miner of the Larch.[2]—The only other insect that I know of which causes serious injury to larch in this country is a small tineid moth, *Coleophora laricella.* This is extremely prevalent almost every year in some of my own plantations having a south-west aspect, and has been supposed by some authors to be directly connected with the attacks of Peziza, which usually accompany or succeed it. According to Stainton the larva is hatched in the autumn, and at first feeds as a miner inside the leaves, and at the approach of winter retires to the stem of the tree, where it passes the winter without feeding. In the spring as soon as the leaves appear it begins to work, and frequently becomes so numerous that most of the buds have several leaves injured. In May it is fully fed, and attaches the case which it has formed for itself from the leaves of the tree to a twig, and appears as a perfect insect in July. The tree is undoubtedly very much weakened by severe and repeated attacks, which render it more liable to die from Peziza, but as far as I know there is no practicable remedy for it in plantations.

A new enemy to the larch which has recently appeared in the north of England was described in the *Journal of the Board of Agriculture* in 1906, p. 375, and more fully in a paper by Mr. J. Smith Hill.[3] This is the larva of a sawfly, *Nematus Erichsonii*, Hartig, which was first noticed about 1904 by Mr. Cyril F. Watson, of Cockermouth, and which has done considerable damage in the Lake district of Cumberland by defoliating the larch. Mr. Gillanders has recently found the larva near Rothbury, and Mr. Forbes in Chopwell woods, but I have not heard of its appearance in the south of England.

I am informed by Mr. R. D. Marshall, of Castlerigg Manor, that he has known periodical visitations of the same insect for several years, and that, owing to the late period of the season at which the larva appears, the trees have not suffered as seriously as they would if attacked earlier. He states that the plantation alluded to by Mr. Smith Hill first suffered from this cause as much as forty years ago, and has survived the attack in three consecutive years recently. It was noticed that during these seasons the plantation was full of small birds, which were apparently feeding on the larvæ.

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[1] *Journ. Roy. Hort. Soc.* 1892, p. 170.

[2] Cf. *Gard. Chron.* xxxvi. 181, figs. 70, 71 (1904).

[3] *Quarterly Journal of Forestry*, i. p. 67 (1907).

REMARKABLE TREES

To enumerate all the larches which are remarkable for their size and age in Great Britain would be impossible, as in almost all places of sufficient age or importance this was one of the first exotic conifers to be planted, but it will suffice to say that many still exist in a sound condition which are 150 years or more old and exceed 100 feet in height. The tallest trees I have ever heard of were felled about the year 1890 in a deep valley near Croft Castle, Herefordshire, the seat of Capt. H. Kevill Davies, which I visited in 1904 under the guidance of Mr. Openshaw, who assured me that some trees there were 135 feet long at the point at which the tops were cut off, with a diameter of 6 inches. This was confirmed by the woodman on the estate, H. Prince, who estimated the tops to have been 10 to 15 feet long, making the trees nearly if not quite 150 feet high.[1] The soil is Old Red Sandstone and the situation very sheltered. I have a record of a tree measuring 134 feet by 10 feet 8 inches which grew in Yorkshire on Lord Masham's estate, and at Penrhyn Castle, North Wales, Henry measured a tree 118 feet by 7 feet 10 inches, and I saw another at the same place growing in a low, very wet, almost swampy situation very near the sea among hardwoods which was about 90 feet by 12 feet, and judging from the rings of felled trees lying near it was about 130 years old. This is remarkable from the fact of the conditions of growth being so extremely unlike those which are usually considered natural to and suitable for the larch, and I can only explain them by the fact that the natural drainage was better than it seemed. Certainly I would not expect larch now planted in such situations to escape disease.

At Ombersley Court, Worcestershire, the seat of Lord Sandys, a tree is growing on the lawn in deep red loam, which exceeds in girth any larch that I know of in England. It is no less than 15 feet 7 inches at five feet from the ground, though it falls away rapidly higher up, and is only about 80 feet high, and has very large and wide-spreading branches.

At Stoneleigh Abbey, Warwickshire, the seat of Lord Leigh, there are some very large and picturesque larches, near the park-keeper's house, which look as old as any in England. One of them, measuring 14 feet 8 inches in girth, has a mass of rugged branches, some of which touch the ground, where they seem to have taken root. Another is about 80 feet by 14 feet. In the grounds of Warwick Castle there is a group of seven ancient larches, as well as one in the castle yard whose top curves into a drooping form.

In Gloucestershire there are many fine trees of this species on the Cotswold hills, among which may be mentioned two near the Woodhouse in Earl Bathurst's woods (Plate 98). These are growing on dry and rather shallow soil, overlying Oolite rock, and are over 100 feet high by 11 feet and 12 feet in girth respectively.

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[1] Mr. T. E. Groom of Hereford writes to me that he measured several of these trees himself, and has a clear recollection that two of them were over 140 feet long as topped for sale, where they would be 5 or 6 inches in diameter. The quarter-girth under bark half-way up was, however, only about 14 inches, which gives their cubic content as about 190 feet.

They seem to have been drawn up by surrounding trees, though now open on one side; and the fine trees beside them are Lawson Cypress, about fifty years old. At Sherborne House, the seat of Lord Sherborne, is a fine group of six old larches on the lawn, planted in a circle of very small diameter, which seed freely, and from which I have raised good plants. They are remarkable for their symmetry and equality rather than for their great size (Plate 99). At Mickleton Manor I measured in 1903 a very curious larch, 10½ feet in girth, but of no great height, whose branches spread to a distance of over twenty yards from the trunk. Plate 100 shows the tallest larches which I have measured myself in England, growing on a very dry, stony bank, composed of Oolite gravel, at Lyde, near Colesborne. These have no doubt been drawn up by the surrounding beeches to their great height, which exceeds 120 feet, the tallest, whose top is now dying, was, when measured in 1903, about 125 feet; but their girth is only 7 to 8 feet. They are remarkable from the fact that a part at least of their roots is under water, and must derive some part of their nourishment from the decaying beech leaves which accumulate there, as the trees higher up the bank are not nearly so large.

The tallest larch mentioned by Loudon in England was at Strathfieldsaye, where one was recorded as being 130 feet high by 3 feet 6 inches in diameter; but none over 80 feet were reported at the Conifer Conference in 1891. At Eridge Park, Kent, are some very fine larch trees growing on sandy soil, in what seems a damp situation below sandstone rocks, which average well over 100 feet in height, and one which I measured was 115 feet by only 5 feet 3 inches, a very unusual proportion of height to girth. Mr. R. Anderson has heard of a tree which was felled near Moorhampton which contained 356 cubic feet as measured over bark on the railway, and trees of over 200 cubic feet were not uncommon near this place. At Savernake House, Wilts, he has measured a tree 12 feet in girth, and tells me that the growth on this estate is sometimes so rapid that eight or nine rings may be found together with an average width of half an inch.

In the north-western counties there are, or have been, many very fine larches. Sir Maurice Bromley Wilson tells me of two on the shores of Windermere, which he thinks are the largest in the Lake district; but the best I have seen myself are at Greystoke Castle, the seat of the Howards of Greystoke, where Lady Mabel Howard showed me a tree in a plantation near the castle called John-by-Park, which is believed to have been planted by Charles, eleventh Duke of Norfolk, about 130 years ago, and which measured 11 feet 10 inches at 5 feet from the ground, and contains about 230 cubic feet. There are also two trees, taller but not so thick as the one at Greystoke, in the sunken garden at Lowther Castle in the same district.

In Wales the larch has been planted as extensively as in England on most of the large estates, and as a rule grows as well as, or better than, in England up to 800 or 1000 feet above the sea. Among the most remarkable trees are two at Chirk Castle, Denbighshire, the seat of R. Myddelton, Esq., one of which measures 74 feet by 13 feet 5 inches, and has very wide-spreading branches. The other forks low down and is 12½ feet in girth. At Maesllwch Castle, Radnorshire, the seat of

W. de Winton, Esq., there is a very fine group of twelve old larches 90 to 100 feet high, the largest of which measured 11 feet 10 inches, 11 feet 1 inch, and 10 feet 6 inches in girth when I saw them in 1906. At Dynevor Castle, in a low-lying damp spot, there is a very fine larch about 100 feet high and 9 feet 10 inches in girth, which may contain as much as 300 feet of timber. At Hafod, in Cardiganshire, the seat of T. J. Waddingham, Esq., there were planted in the year 1800 400,000 larch trees on a surface of 44 acres, for which the then proprietor, J. Jones, Esq., obtained a gold medal from the Society for the Encouragement of Arts.[1] Of these, I am informed by M. D. Barkley, Esq., many still remain, and a section of one which he sent me shows that they have grown to magnificent trees. As a rule, however, the large plantations in Wales are not allowed to stand to any great age, being more valuable when large enough to make pit timber.

In Scotland the number of larches remarkable for their size is so great that it is not easy to make a selection, almost every large estate, especially in the Highlands, having splendid trees of great age. So far as I can learn, the trees on Drummond Hill, near Taymouth Castle, the Perthshire seat of the Marquis of Breadalbane, are actually the largest in Great Britain. I visited this place in April 1904 and carefully measured the best trees myself. They are growing on the slope of a hill facing south in good open loamy soil, overlying rock, from which, in some places, springs of water rise; and seem to owe their immense size in part to the fact of their having been mixed with beech and oak, which were planted at or about the same time, and which they have far surpassed in height. The finest tree is figured in Plate 101, and is about 115 feet in height by 17 in girth. It carries its bulk very well up to at least fifty feet, where some large branches go off, and contains, according to Mr. Peter Mackay, the forester, over 500 feet of timber. I estimated the first length alone at 450 feet, the next at 100 feet, and the top and branches at about 50 feet more, so that this tree must contain nearer 600 than 500 cubic feet. In November 1893 a tree near it on the same hill was blown down, and the butt, which was sold, weighed ten tons on the railway, or about 500 cubic feet, besides which three tons more were cut up on the estate. Near it is a tree (Plate 102) remarkable for being divided at about 20 feet up into four large upright stems, a rare occurrence in this species. It is nearly the same height and girth as the first, and may contain as much timber. A third, as measured by the forester, has a bole of only 6 feet long, girthing at 1 foot from the ground no less than 24 feet, and at 5 feet 17 feet 9 inches; it divides into two huge trunks over 100 feet high. These trees are believed to be from 160 to 180 years old, and were probably planted as early as those at Dunkeld.

The next largest and probably the best known larches in Scotland are the so-called Mother Larches, which stand close to the ruins of the Cathedral at Dunkeld (Plate 103), and which were planted, according to the inscription on a stone slab in the wall close by, in 1738 by James, third Duke of Atholl, who, according to Hunter, obtained them from Mr. Menzies of Culdares, who brought a few small plants from the Tyrol in his portmanteau; but in an account of the larch plantations on the estates of Atholl and Dunkeld, published in the *Transactions of the Highland Society*

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[1] Michie, *The Larch*, 63 (1885).

(vol. v.), which is largely quoted by Loudon, it is said that Mr. Menzies of Migenny was the introducer, and Walker[1] gives 1727 as the date of their introduction. When measured in 1831, Loudon says that the largest was 100 feet by 10 feet 6 inches at 5 feet from the ground. In 1888, according to the tablet mentioned above, it was 102 feet high, and girthed at 3 feet 17 feet 2 inches, at 5 feet 15 feet 1 inch, at 17 feet 12 feet 10½ inches, at 51 feet 8 feet 8 inches, and at 68 feet 6 feet 1 inch, the estimated contents being 532 cubic feet. When measured by Mr. Keir, forester to the Duke, in 1899 it was 15 feet 6 inches in girth; and I made it in 1904 15 feet 8 inches and 100 feet high; so it is still growing and vigorous, though the smaller tree beside it has lost most of its top and many of its branches.[2] There are many other fine larches on this estate, of which the largest perhaps, on the Kennel Bank at Dunkeld, is 120 to 125 feet high by 11 feet 10 inches in girth, with sound top and clean bole to 50 to 60 feet, containing about 350 feet of timber. Three trees of the same age as the Mother Larches are growing near the Castle at Blair Atholl, but are not nearly as large or well shaped.

At Gordon Castle there are some fine larches, one of which, growing in a plantation called Cotton Hill, exposed to the full blast of the North Sea, is figured on account of its remarkable trunk (Plate 104). An immense limb comes off close to the ground, where the trunk girths 20 feet 6 inches, and at about 5 feet, where the tape is seen in the plate, it is 11 feet in diameter. The branches spread to at least 15 yards on each side and measured 198 feet in circumference, and the tree in April 1904 was covered with fine cones, which were beginning to shed their seed, and from which I have raised some plants.

At Monzie Castle, near Crieff, are some splendid larches of the same age and origin as those at Dunkeld, of which the largest, according to Hunter, was 100 feet by 16 feet 3 inches, and contained about 380 feet of timber when he wrote in 1883. I have not seen these trees myself, but Henry measured the largest in 1904 as 109 feet by 17 feet 4 inches, and describes them as very beautiful trees with immense pendent branches in full health and vigour. Hunter says that John, fourth Duke of Atholl, called "the Planting Duke," because he is said to have planted over 10,000 acres of larch, considered them to be the only rivals to the Mother Larches at Dunkeld, and sent his gardener every year to report on their progress. They are figured by Michie on p. 205.

At Inveraray there are some very fine larches on the level ground near the Castle. The best that I measured was about 110 feet by 11 feet, but there may be taller ones;[3] none approached the silver firs in the same locality in height or girth. They serve to show, however, that the larch will succeed well in a climate as unlike that of its native mountains as it is possible to find in Scotland, provided the soil is good and there is shelter from the west wind.

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[1] *Economic History of the Hebrides and Highlands*, ii. 214 (1812).

[2] I was told by Mr. Keir in 1906 that the largest tree had lately been struck by lightning and was now quite dead.

[3] In *Old and Remarkable Trees of Scotland*, p. 64, it is stated that a larch at Ben-an, in the parish of Inveraray, was 130 feet high and 10 feet in girth at 3 feet, and others are reported at Glenarbuck, in the county of Dumbarton, and at Auchintorlie, in the same county, 143 feet and 140 feet high, but these latter measurements are not reliable, and have never been confirmed. Mr. Renwick has recently measured the Auchintorlie tree, and finds it only 95 feet high.

In the *Scottish Arb. Soc. Trans.*, viii. 233, J. Hutton states that at Keppoch, in Inverness-shire, there were in 1878, 124 larch trees, said to have been brought home as two-year seedlings by Ranald Macdonald of Keppoch in 1753. They grew on an area of about eight acres, and had an average height of about 90 feet, and were then estimated to contain altogether 18,848 cubic feet of timber. The two largest, close to the banks of the Roy, were 108 feet by 12 feet 2 inches, contents 355 feet, and 86 feet by 14 feet 7 inches, contents 358 feet; and he mentions that upwards of forty similar trees were blown down in 1860, so that the timber on this area would have exceeded 3000 feet per acre. This property now belongs to the Mackintosh of Mackintosh, whose forester, Mr. A. Rose, tells me that at the present time there are only seventy-seven trees left, of which twenty-five are small ones which have suffered from various causes; the remaining fifty-two are fine trees with an average content of 120 feet, making, together with the smaller ones, only 7192 cubic feet in all. The largest now standing, which is about twenty-five yards from the banks of the Spean, is 74 feet by 18 feet 6 inches at 3 feet from the ground, and contains 395 cubic feet. The tallest is 108 feet by 11 feet 2 inches. The two largest in 1878 have both been since cut on account of decay, but the rings counted on the stump were 123 and 131 only, which does not agree with their reputed history.

There are very tall and large larches at Brahan Castle and elsewhere in East Ross, one of which was reported by Mr. Pitcaithley[1] as being 115 feet by 11 feet. Mr. Munro-Ferguson tells me that a very large larch was recently felled on his property at Novar; and his factor, Mr. Meiklejohn, sends me the following measurements:—at 5 feet from the ground 12 feet 8 inches, at 25 feet 10 feet, at 40 feet 9 feet 4 inches. The cubic contents of the trunk were 400 feet, and the branches probably contained 50 more.

The highest elevation which I found recorded for the larch in Scotland is in the Ballochbuie forest, where three larches of great size were reported, in 1860, to be in a sound condition at 117 years old and 1110 feet above the sea.

Michie[2] gives a long account of some fine larches growing in the Paradise at Monymusk, in Aberdeenshire, with details of their measurements; the largest in 1881 was 100 feet by 10 feet 5 inches at 20 feet from the ground, and was supposed to contain 416 cubic feet.

A remarkable instance of the manner in which the roots of the larch may continue to grow after the tree has been cut is described and figured in *Gardeners' Chronicle*[3] from a specimen submitted by the late Mr. Webster, head gardener at Gordon Castle. The figure shows the felled stump, rotten in the centre, and with the new wood surging over the edges of the wound, and also two roots of the foster tree, inosculating by means of various branches with those of the stump.

The larch has been extensively planted in Ireland, and has given, when grown on ordinary soils, excellent results, as it has usually remained free from disease. As an instance of good growth, Mr. Mitchell, land-agent at Doneraile and an experienced forester, told Henry that many trees cut in 1891 in a plantation on the Kilworth property in Co. Cork must have been 135 feet in height, as he measured them lying on the ground 120 feet to the small end, where they had been cut off at 6 inches diameter. There are still trees as large growing on the same property. Attempts have been made to plant pure larch on peat-bogs; but even when the bogs have been well-drained and good soil has been added to the pits at the time of planting, the trees have not grown. In such cases a preliminary plantation of Scots pine, or in localities with a mild climate the maritime pine, will prepare the bog for larch, which after a few years can be planted in amongst the pines. The conditions for success in bog-planting are delicate, depending apparently on moderate drainage, as when the bogs are quite dry the trees are starved for want of water, and when they are too wet, trees will hardly grow at all. Mr. Richards, forester at Penrhyn, who has had great experience, is confident that good larch can be grown on peat-bogs; and isolated trees doing well on peat have been seen by Henry in various parts of Ireland. Experiments with larch and various mixtures of trees that will grow easily on bogs should be attempted. The American larch has never been tried, and possibly might succeed better than the common species, as it is a swamp-loving tree.

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[1] *Trans. Scot. Arb. Soc.* xi. 505.

[2] *The Larch* (1885).

[3] *Op. cit.* 31st Aug. 1872, p. 1161.

The most remarkable old larches in Ireland are at Doneraile Court in Cork, the seat of Lord Castletown. The history of these trees, which were seen by Henry in February 1907, is obscure, but there is a tradition that they were sent in the eighteenth century to Doneraile by the Duke of Atholl. Five trees out of six originally planted now remain, all of peculiar habit, with numerous more or less weeping branches, the lowermost of which spread over the ground to a great distance, and in one tree are layering. This tree is about 70 feet high, and is 12 feet 7 inches in girth at 5 feet from the ground, the base of the tree below 4 feet being much swollen and covered with very thick bark, like that of old trees in the Alps. On one side the branches spread to 70 feet distance, and on the other side, where there was less room on account of other trees, to 30 feet. Another tree, 10 feet 10 inches in girth, has a spread of 91 feet in diameter. None of them attain more than a moderate height, which is difficult to explain, as ordinary larch grows very tall in the neighbourhood. From the seed of the old trees, sown in 1890, plants were raised, which were put out in 1893 on a hillside, seven acres in extent, and with good soil. This small plantation is now remarkably healthy, though the trees are very dense on the ground, and, at seventeen years old from seed, they average 37 feet in height and 20 inches in girth.

At Carton Park, the seat of the Duke of Leinster, there is a curious tree with the trunk inclined and pendulous branches, which was in 1903 60 feet high and 9 feet in girth. It is considered to be one of the original importations from Scotland in the 18th century. A fine tree in the same place with a straight stem measured 98 feet by 10½ feet. At Abbeyleix House, the seat of Viscount de Vesci, a tree is growing on the lawn similar to those at Doneraile in having weeping branches, some of which are layering. At Dartrey Castle, Co. Monaghan, the seat of the Earl of Dartrey, there are three very old trees, also with more or less pendent branches, which were in 1903 13 feet 10 inches, 13 feet 8 inches, and 11 feet 7 inches in girth respectively. At Emo Park, Queen's

County, the seat of the Earl of Portarlington, there are about twenty fine trees in the pleasure ground, one of which measured in 1907 105 feet by 7 feet 9 inches, another being 92 by 10 feet.

LARCH IN THE ALPS

In its native home the larch loves a dry cold winter climate, where the snow lies from December to April or May, and at the higher elevations does not begin to vegetate before the end of the latter month. It is not very particular as to the geological character of the soil provided that the rock is sufficiently disintegrated for the roots to penetrate and there is a fair amount of soil in which the seeds can germinate, and as a rule natural reproduction is fairly regular and abundant. It is not often allowed to attain its full age, which may be 150 to 300 years or more, on account of the value of its timber for building and other purposes.

As to the size it attains in its native home I have few exact particulars. The largest that I have measured myself was near Modane, in the forest de Villarodin, at 4500 feet elevation, growing on schist with a north aspect. This tree, said to be the largest in the district, was about 90 feet high by 16 feet in girth, but tapered rapidly, and would not contain more than about 200 feet of timber.

By far the finest specimen of the larch in the Alps is figured in Plate 105, made from a negative which was very kindly lent me by M. Coaz, Chief Forest Inspector of the Swiss Forest Department, and which is described in *Les Arbres de la Suisse*[1] as follows :—

"The larch of Blitzlingen grows opposite the little village of this name in the district of Conches in the upper Valais at an elevation of 1350 metres. At the foot of a slope facing north-west, on a narrow terrace this tree grows in a deep and fresh loam, rich in humus, and overlying gneiss rock. There it has become one of the largest in Switzerland, and measures at its base 8 metres 70 cent., and at 1½ metre is still 7½ metres in girth. Its branches extend 10 metres from the trunk. Its top is dead, and thus it is only 29 metres high. Strongly attacked by decay, its trunk does not allow its age to be exactly determined, but no one can accuse us of exaggeration if we estimate it at about five centuries."

According to Dr. L. Klein, who gives an excellent account of the larch,[2] it sometimes attains in the Alps an age of 600 to 700 years. Some stumps which he saw in the so-called Park of Saas-Fee, in the canton of Valais, showed that number of rings, but these trees did not exceed from 1 to 1½ metre in diameter. Dr. Klein counted on a sawn stump near the Findelen glacier 417 annual rings in a diameter of 85 centimetres. He gives several excellent illustrations of Alpine larches taken near the Riffel Alp, one of which shows a tree forking close to the ground into four stems, and another a so-called Candelabra larch with branches rising parallel to the main stem.

[1] Schmid u. Francke, *Baum Album der Schweiz* (1900).

[2] Karsten u. Schenck, *Vegetationsbilder*, ii. tt. 25-28 (1905).

LARCH IN OTHER COUNTRIES

In Norway, so far as I have seen, the larch does not grow well on the coast, though there are fine trees 70 to 80 feet high at a farm called Kjostad near Trondheim, and in the interior and farther south. Schübeler tells us that it has been successfully grown as a forest tree, especially at Brandvold, in the Glommen valley, where trees planted in 1803 had attained in 1878, according to Forstmeister Mejdele, from 70 to 95 feet high, the largest having a diameter of 14 inches at 58 feet from the ground. A very large tree said to be 150 years old existed in 1866 near Gothenburg in Sweden.

The larch is one of the few European trees which appears to grow really well in New England. The following instances of its success are recorded in *Garden and Forest*:—vol. ii. p. 9, an acre of larch planted in 1877 by Mr. T. H. Lawrence of Falmouth, Mass., on gravelly soil, in an exposed situation, a mile from the coast, was awarded a prize in 1888, when the trees formed a regular and complete cover on the ground, and many of them were over 25 feet high; vol. iv. p. 538, records the success of a plantation made by Mr. J. Russell at East Greenwich, Rhode Island, with 100 small seedlings costing one dollar, which were planted in 1879, and in 1891 were 20 to 27 feet high. Here the larch has been planted alternately with the native *Pinus Strobus*, to which they form an excellent nurse. In 1896 Sargent (vol. ix. p. 491) speaks of it as a tree likely to produce valuable timber in the northern states; but in Virginia, on the lower Chesapeake river, the climate is too wet and hot for it, and the trees did not thrive (vol. i. p. 500).

European larch has been tried in various places in the Himalaya, but not with much success, those at Manáli, in Kulu, being apparently the most successful; in 1881 young trees four years old were 6 feet high.

TIMBER

The value of larch timber for all purposes where durability and strength are required has been so well known for so many years past and is so fully dealt with by Loudon, Michie, "Acorn," and many other writers that I need not say very much about it. There is no home-grown timber so generally used on estates for building and fencing, and though its price has fallen considerably of late years on account of the increasing competition of foreign timber, it is likely to remain in demand, and is easier to market at all ages than almost any timber except ash.

The only country from which larch timber is at present imported or from which any possible supplies can come in future is the north of Russia, and this at present is not used to any great extent; but shipbuilders, collieries, and railway companies are not buying home-grown larch so freely as they used to do except in districts where it can be procured close at hand.

For long telephone poles, for bridge-building and other purposes where lengths of 50 feet and upwards are required, heavy larch poles exceeding 50 cubic feet fetch prices of from 1s. 2d. to 1s. 4d. a foot standing, and cannot always be procured when wanted. But the greater strength and durability of the red heartwood in trees of great age does not command the increased price which it ought to be worth, and it is often best to keep this for private use and sell the smaller and younger trees, whose timber cannot be expected to last as long. For trees of 30 to 50 cubic feet 1s. per foot and upwards, if not too far from a railway, is about the present price. For trees of 15 to 30 cubic feet 9d. to. 1s. should be realised, and for small thinnings the price fluctuates according to the local demand for fencing, hop-poles, and pit-timber.

On account of the durability of larch wood under water, it is specially adapted for piles, wharves, and groins; but owing to its propensity to warp and twist and the difficulty of sawing, planing, and jointing it in comparison with most other coniferous woods, it is seldom used for inside work. It makes very handsome panelling, however, if the red heartwood is carefully selected and seasoned, and is preferred to all other woods in its native Alps for building log-houses, which in some cases are known to have remained sound for 400 years.

The Duke of Atholl informs me that the larch used in the construction of the stables at Dunkeld in 1809 appears to be still quite sound; and I saw at Blair Castle a handsome table 5 feet in diameter made from a transverse section, laid as veneer, of a larch grown on the property, which shows eighty-seven annual rings. In the museum at Innsbruck I saw a very handsome antique chest made from very dark-coloured larch wood, which had been dug out of the ground, akin to bog oak in character; and the wood is used in conjunction with that of *Pinus Cembra* for making artistic furniture by Messrs. Colli Brothers of Innsbruck.

For ship- and boat-building it was at one time much more used than at present, and knees cut from its roots are at least as strong and durable, if not more so, than oak knees.

The bark, though used to some extent for tanning, is now seldom worth stripping except in the case of large trees felled in the spring, when, if taken off in large slabs, it makes a very durable covering for summer-houses, sheds, and other rustic buildings.

Venice turpentine is a resinous product of the larch formerly much valued in medicine and surgery, and for making varnish, of the production of which Loudon gives ample details; but like so many similar products, it has gone out of use in this country at least, but is still sold in Venice, where I procured a sample of it. Manna of Briançon is a saccharine exudation from the leaves of the tree in the form of small white opaque grains which formerly had some repute in medicine.

(H. J. E.)

LARIX SIBIRICA, Russian Larch

Larix sibirica, Ledebour, *Fl. Alt.* iv. 204 (1833); Willkomm, *Forstliche Flora*, 153 (1887); Kent, *Veitch's Man. Coniferæ*, 402 (1900); Mayr, *Fremdländ. Wald- u. Parkbäume*, 311 (1906).

Larix intermedia, Lawson, *Agric. Man.* 389 (1836); Turczaninow, *Bull. Soc. Nat. Mosc.* xi. 101 (1838).

Larix archangelica, Lawson, *loc. cit.*

Larix europæa, De Candolle, var. *sibirica*, Loudon, *Arb. et Frut. Brit.* iv. 2352 (1838).

Larix rossica, Sabine, *ex* Loudon, *Encyl. Trees*, 1054 (1842); Trautvetter, *Act. Hort. Petrop.* ix. 211 (1884).

Larix altaica, Nelson (Senilis), *Pinaceæ*, 84 (1866).

Larix decidua, Miller, vars. *sibirica* and *rossica*; Regel, *Gartenflora*, xx. 101, t. 684, ff. 1, 2, and 4 (1871).

Pinus intermedia, Fischer, *Scht. Anz. Entdeck. Phys. Chem. Nat. et Techn.* viii. 3. Heft. (1831). (Not Wangenheim.)

Pinus Ledebourii, Endlicher, *Syn. Conif.* 131 (1847).

Abies Ledebourii, Ruprecht,[1] *Beit. Pflanz. Russ. Reich.* ii. 56 (1845).

A tree attaining in Siberia over 100 feet in height and 9 to 12 feet in girth. Bark resembling that of the European larch. Young branchlets slender; in specimens from the Ural mountains and Tobolsk, pubescent with long hairs in the furrows between the pulvini; in specimens from the Altai, glabrous; girt at the base by a sheath of the previous season's bud-scales, within which a ring of pubescence is visible. Branchlets of the second year glabrous, greyish-yellow, shining. Terminal buds broadly conical, resinous, with ciliate scales. Lateral buds hemispherical, dark brown, resinous. Apical buds of the short shoots broadly conical, girt at the base by a dense ring of pubescence. Leaves soft in texture, very long and slender, up to 2 inches in length, narrower than in *L. europæa*, sharp-pointed, agreeing with that species in the arrangement of the stomata, but more deeply keeled on the lower surface. Staminate flowers as in the European larch. Pistillate flowers according to Willkomm, ovoid, pale green. Cones, when unopened, cylindrical, with the terminal scales not gaping and the bracts quite concealed; variable in size, up to 1½ inch long, composed of five spiral rows of scales, five to six scales in each row. Scales convex from side to side and also from the base to the apex, quadrangular, about as long as broad (½ inch); upper margin rounded or truncate, thin, entire, not bevelled, inflected; outer surface finely striate, covered with a reddish-brown pubescence, which is most marked towards the base of the scale. Bract ovate or oblong with a cuspidate point, extending about one-third the height of the scale. Seeds lying on the scale in shallow depressions, with their wings widely divergent and not extending to its upper and outer margin. Seed ⅛ inch long; with its wing ½ to ⅝ inch long; wing about ⅛ inch in width, broadest about the middle.

This species is amply distinct from *L. europæa*, differing in the long and slender leaves, which appear about ten days earlier in the spring; and in the cones, which have fewer and differently shaped scales and short concealed bracts. In the Siberian larch the scales are convex both laterally and longitudinally, whereas in the European larch they are flattened longitudinally. The seeds, moreover, of the former have longer and differently shaped wings, and do not cover the scales of the cone up to their margin as is the case in the latter.

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[1] This name is quoted wrongly as *Larix Ledebourii*, Ruprecht, in *Index Kewensis*, ii. 31, and in Sargent, *Silva N. Amer.* xii. 4.

VARIETIES

In wild specimens both pubescent and glabrous branchlets occur. Cones from a tree, cultivated in the Botanic Garden at St. Petersburg, differ in being narrowly cylindrical, with oblong scales only half the width of wild specimens; and the bracts are also much narrower. The seeds, however, lie on the scales as in wild specimens; and the scales have the convex form and inflected upper margin of typical *L. sibirica.*

A supposed variety, *rossica*, occurring in northern Russia, was distinguished by Regel as having small cones; but as Beissner informs me in a letter, it was subsequently abandoned by Regel, and is now not noticed by Willkomm or by any Russian botanist. Sir C. Wolseley, Bart., vice-consul at Archangel, has kindly sent me excellent fruiting specimens from Archangel, which differ in no respect from the Ural larch.

DISTRIBUTION

The Siberian larch has an extremely wide distribution, occurring in north-eastern Russia and throughout a great part of Siberia.

In European Russia it occurs wild in the governments of Archangel, Vologda, Viatka, Perm, and Orenburg. According to Korshinsky,[1] it grows rather sparingly in the plains of northern Russia, as isolated trees in the pine forests; whereas on the mountains of the Ural chain and its branches it forms extremely large forests, sometimes pure, and sometimes mixed with pine and spruce. Its exact distribution is differently stated by various Russian authorities. Herder[2] adds to the preceding provinces Ufa, Olonetz, eastern Finland, and the northern parts of Kostroma and of Nijni-Novgorod. Ruprecht[3] states that it commences to grow in the northern part of the government of Olonetz beyond the city of Kargopol, from whence extensive woods of it stretch to the Ness river in the Kanin peninsula. In this peninsula it attains its most northerly point in Europe, on the Arctic circle. Further east its distribution sinks to the southward, and its most northerly point on the Ural range is about 58° latitude.

Its distribution in Siberia is not yet clearly known, as it has been confused with *Larix dahurica.* It would appear to be the species common in middle and southern Siberia west of Lake Baikal, while *Larix dahurica* apparently occupies eastern Siberia and Manchuria, a close ally of it, *Larix Cajanderi*, occurring in the extreme north in the lower part of the valley of the Lena, north of lat. 63°. *Larix sibirica* is reported from Olga Bay in Manchuria, but this requires confirmation; and it has been supposed to occur in Mongolia and north China; but Mayr has recently described the North China larch as a new species—*Larix Principis Rupprechtii.* In Siberia its most northerly limit is lat. 69° on the Yenesei and Kolyma, its southern limit extending from the Ural at lat. 54° to the Altai in lat. 52°.

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[1] *Tent. Fl. Rossiæ Orientalis*, 493 (1898).

[2] *Act. Hort. Petrop.* xii. 101 (1892).

[3] *Loc. cit.*

The Siberian larch was reported by Kanitz[1] to occur as a shrub in upper and middle Moldavia at about 6000 feet elevation. He identified it on the authority of Parlatore in a letter. I have seen no specimens from this locality, and consider the identification very doubtful.[2] (A. H.)

An excellent account is given by Mayr[3] of a plantation of this tree which was made in 1750-1760 for the Czarina Elizabeth at Raivola on the Russian-Finnish frontier north of St. Petersburg. The seed was procured from Ufa, and the trees have on the better land grown remarkably straight and clean without branches for 20 metres up, and attain 40 metres in height with a diameter of 70 centimetres. The wood of these trees, which was shown at the Paris exhibition of 1900, was of remarkably good quality, and Prof. Mayr recommends this tree strongly for cultivation. But as summer does not commence in Finland until June, and the trees had already turned yellow on September 18th, it is probable that the species is not unlikely to succeed in Great Britain except perhaps in elevated districts in the north and east of Scotland.

On my journey to Siberia in 1897 I saw larches in the Ural mountains near Zlataoust, but only after passing the watershed into Asia, and these were of no great size. In the Altai they first appeared at about 3000 feet, and at 4000 feet they became more numerous and larger, some of them 3 feet to 4 feet in diameter and about 100 feet high, but nearly all were dead at the top, and not yet in full leaf on 7th June. They grow scattered in open forest on the drier hillsides as well as on marshy flats, and where the soil is damper are often mixed with *Picea obovata.*

Farther to the south in the upper valleys of the Katuna and Tchuya the larch became the prevalent tree, and extends to a higher elevation than any other, following the banks of the mountain streams on the Mongolian frontier up to about 7500 feet. At this elevation I saw a grove of young larches from 8 to 15 feet high, and cut one of the smallest to count the rings, of which there were twenty-five in a diameter of only 1½ inch. Some of the old trees were remarkably stunted, only 10 to 12 feet high and 5 feet to 6 feet in girth. In this region the climate is extremely severe, frost and snow occurring even in July. The bark of the tree is used all over the region where it grows for covering the winter huts of the nomad Tartars, which are in shape and construction very like the lodges of the Indians in Montana.

CULTIVATION

It was introduced by the Duke of Atholl in 1806 from Archangel, as stated in the fourth volume of the *Transactions of the Horticultural Society*, p. 416, and was described as follows:—"The bark quite cinereous, not of a yellowish-brown colour, and not distinctly scarred as in the common larch, but, on the contrary, the vestiges of the scars are scarcely visible; the leaves come out so soon that they are liable to be injured by spring frosts, and what is remarkable, the female flowers are not produced till some time after those of the European larch appear; they are like those of *Pinus* (*Larix*) *microcarpa*. Mr. Sabine has a plant of this sort in his garden at North Mimms, which he received under the name of *Larix sibirica* from Messrs. Loddiges, who obtained the seed originally from Professor Pallas, whose *Pinus Larix* it probably is. He contrasts the cinereous bark of his plant with the pale brown colour of the common larch; it may probably prove to be a distinct species." So far as I can learn no trees of this introduction are now living at Dunkeld.

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[1] *Plant. Romaniæ*, 139 (1881). Cf. also Janka, *Flora Siebenbergens*, xvi. 366 (1866).

[2] See distribution of the European larch.

[3] *Loc. cit.* and *Naturw. Stud. Nordw. Russl. Allg. Forst. u. J.-w.* 1900.

Large quantities of seed were procured by Messrs. Little and Ballantyne of Carlisle, and raised in their nurseries about eight years ago, but the trees from them have generally been a complete failure owing to the very early bursting of their leaf-buds.

I received in 1902, from the Tula Government, through Professor Fischer de Waldheim, some seed of the Siberian larch, and a few of the seedlings look rather more promising than those from North Russia; but we are not aware that any fair-sized tree of this species now exists in England.

In December 1902 I received seed of this tree from Herr E. Rodd, which was gathered in the Ouimon valley in the Altai mountains early in September, but he tells me that it is not naturally shed there until spring. This seed germinated, but the plants raised from it are small and unhealthy, and vegetate very early in the spring, so that they seem likely to grow as badly in this climate as the larch from the Ural.

In England, as a forest tree this species seems likely to be worthless, for it opens its leaves so early, and suffers so much from spring frost, that with few exceptions the young trees I have grown are unhealthy, and many have already died, though planted in a very cold and exposed situation.

In the north of Norway I saw it growing at the Government nurseries in Saltdalen in 1903 from Russian seed sown in 1882. Trees only 15 feet high were already bearing cones, but were much healthier and more vigorous than the common larch; and in the Botanic Garden at Christiania I noticed that though growing at the rate of a foot annually, the leaves were attacked by a Chermes like *C. laricis*.

TIMBER

The tree is common in the north of Russia, where it forms a large part of the forests on the east side of the White Sea; and in the valley of the Petchora, seems to attain very large dimensions. Seebohm[1] says that Alexievka at the mouth of this river is the shipping port of the Petchora Timber Company, where ships are loaded with larch for Cronstadt. "The larch is felled in the forests 500 or 600 miles up the river, and roughly squared into logs varying from 2 to 3 feet in diameter. It is floated down in enormous rafts, the logs being bound together with willows and hazel boughs. These rafts are manned by a large crew, many of whom bring their wives with them to cook for the party, sleeping huts are erected on the raft, and it becomes to all intents and purposes a little floating village, which is frequently three months in making the voyage down the river."

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[1] *Siberia in Europe*, 174 (1886).

This larch is now shipped to London in some quantity for various purposes, and has been considerably used for piles in the Dover harbour works, and elsewhere. Mr. D. J. Morgan of Morgan Gellibrand and Company informs me that it is one of the most durable timbers that can be used, but so hard that when it is being sawn water is poured on the saw to keep it from heating, and this is probably the reason why it is not much used in England. He informs me that all the lighters at Onega were built of larch timbers, which lasted a very long time, and that when an old house at Archangel, which had been built on a foundation of larch logs, was pulled down, they were found to be quite sound after lying on the ground for possibly a hundred years. The experiments which have been made with it in the quays at the Surrey Commercial Docks, where the wood was continually wet and dry, have proved the lasting power of this wood, which, from what I have seen of it, is much closer in the grain than English-grown larch. But Mr. G. Cartwright, engineer of the Grimsby Docks, tells me that though he has no actual personal experience of its use, it is considered inferior to the best English larch, as indeed its lower price would imply, and inferior in strength and durability under water to English oak, greenheart, jarrah, or even to Danzig red fir, and that for constructional purposes he would consider its value less than half that of large oak.

Messrs. Crundall and Company of Dover inform me that Messrs. Pearson and Sons have used a large quantity of larch deals for their block moulds, and for other purposes where much wear and rough usage is entailed, and the wood has given entire satisfaction. I purchased from Messrs. Howard Bros. and Company of London a long clean log of this tree, from north Russia, in order to compare it with that of home-grown larch, and find the wood is very slowly grown, there being fifteen rings in an inch of radius. The heartwood is less red and apparently much less resinous than that of the European larch. My carpenter reports that when free from knots it works as well as some red deal, and he considers it very well suited for the roofs of plant houses. Its present value is from £11 to £13 per standard. (H. J. E.)

LARIX DAHURICA

Larix dahurica, Turczaninow, *Bull. Soc. Nat. Mosc.* xi. 101 (1838); Trautvetter, *Pl. Imag. Fl. Russ.* 48, t. 32 (1844); Regel, *Gartenflora*, xx. 105, t. 684 (1871); Kent, *Veitch's Man. Coniferæ*, 390 (1900).

Larix pendula, Salisbury,[1] *Trans. Linn. Soc.* viii. 314 (1807); Lawson, *Agric. Man.* 387 (1836); Forbes, *Pinet. Woburnense*, 137, t. 46 (1839).

Larix europæa, De Candolle, var. *dahurica*, Loudon, *Arb. et Frut. Brit.* iv. 2352 (1838).

Larix americana, Michaux, var. *pendula*, Loudon, *op. cit.* 2400.

Pinus pendula, Aiton, *Hort. Kew.* iii. 369 (1789); Lambert, *Pinus*, i. 56, t. 36 (1803).

Pinus dahurica, Fischer, *ex* Turczaninow, *loc. cit.*

Abies pendula, Poiret, *Lamarck's Dict.* vi. 514 (1804).

Abies Gmelini, Ruprecht, *Beit. Pflanz. Russ. Reich.* ii. 56 (1845).

A tree attaining in Saghalien 140 feet to 150 feet in height, but in Siberia usually much smaller. Bark scaling in broad, thin, irregularly quadrangular plates. Young branchlets slender, glabrous, becoming pinkish at the end of the season, shining brown in the second year; older branchlets yellowish grey. Shoots girt at the base by a sheath of the previous season's bud-scales, with no ring of pubescence visible. Short shoots slender, dark brown or blackish, glabrous. Terminal buds globose, glabrous, resinous, with the basal scales subulately pointed. Lateral buds hemispherical, resinous, dark brown, glabrous. Apical buds broadly conical and surrounded by a ring of brown pubescence. Leaves light green, similar to those of *L. europæa* in size and arrangement of the stomata, with the tips usually blunter than in that species.

Staminate flowers sessile, smaller than those of the European larch. Pistillate flowers ovoid, red, with the bracts and scales more closely appressed than in the common larch, making the flower narrower and shorter; bracts slightly recurved, ⅕ inch long, oblong, with a shallow notch at the upper margin between two pointed projections; mucro short, less than $\frac{1}{12}$ inch long.

Cones variable in size, dependent upon the number of the scales, ¾ to 1¼ inch long, cylindrical, slightly narrowed at the apex, where the scales gape open in the ripe cone, composed of three to four spiral rows of scales, six to eight in each row, bracts concealed. Scales longer than broad, about ½ inch long; upper margin rounded, truncate, or slightly emarginate, bevelled, slightly denticulate, not recurved; outer surface glabrous,[2] channelled, shining light brown when ripe. Bracts not exserted, about ⅓ inch long, much shorter than the scales. Seeds lying upon the scale in slight depressions, their wings narrowly divergent and not extending quite to its upper margin. Seed about ⅙ inch long; together with its wing scarcely ½ inch long; wing broadest just above the seed.

The Dahurian larch is a native of eastern Siberia, Manchuria, Corea, and

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[1] Though this is the oldest correct name under the genus, I have not adopted it, as it has been erroneously applied to the American larch, and its use now would cause considerable confusion.

[2] Cultivated specimens, as those from Boynton and Murthly Castle, occasionally have slightly pubescent scales; but the cones and seeds in all other respects are typical of *L. dahurica*.

Saghalien. According to Herder[1] it occurs in the northern Ural range at lat. 68°, and at Nijni Kolymsk in north-eastern Siberia at the same latitude; but it is probable that in the former locality he may be referring to *Larix sibirica*, and in the latter case to the form now distinguished by Mayr as *Larix Cajanderi.* It is uncertain whether the larch which occurs in Kamtchatka is *L. dahurica* or a distinct species.[2]

Larix dahurica is very plentiful on the Stanovoi mountains, and along the southern half of the coast of the sea of Ochotsk. Middendorff found it on the Aldan mountains up to 4000 feet elevation. According to Komarov[3] it forms woods in moist situations in the mountain valleys throughout the Amur, Ussuri, S. Ussuri, and Kirin provinces of Manchuria and in northern Corea. Korshinksy[4] states that it is frequent in the whole Amur region, forming forests in the mountains of the upper Amur and Bureja, but that it does not occur in the plain between the Zeja and Bureja.

It occurs in Saghalien, in the northern half of which it grows mixed with common birch and attains a great size, a fallen tree in the forest having been measured by Hawes[5] as 145 feet in length. Elsewhere it forms part of the coniferous forest of the island, being mixed with *Abies sachalinensis*, *Picea ajanensis*, and *Picea Glehnii.* It also occurs on the island of Shintar.

Elwes saw at Wellesley, Mass., a young larch raised in the Arnold Arboretum from seed received at Petersburg as *L. dahurica*, which had a peculiar growth of the branches, which, according to Prof. Sargent, is seen in all the trees of the same origin. At the commencement of each season's growth the new wood made a distinct angle, turning upwards a little, so that in four years' growth it became erect. Prof. Sargent states that he saw many larches in eastern Siberia which he considered to be *L. dahurica*, and that they all had the same habit. The young trees at Boston have not yet borne cones, but the main stems were making annual growths about 2 feet long, and the tree seemed more at home in that climate than in England.

HISTORY

Pinus pendula was first described by Aiton in 1789; and Solander's[6] MS., on which the description was founded, states that the tree is a native of Newfoundland, with leaves longer and cones shorter than the European larch. A sheet of specimens preserved in the British Museum bears in Salisbury's handwriting "*Pinus pendula*"; three specimens are unmistakable *L. dahurica*; the fourth, a small branch, is *L. americana.*

Lambert's figure of *P. pendula*, published in 1803, is certainly *L. dahurica*, the drawing being made from specimens obtained from a tree in Collinson's garden at Mill Hill which was planted in 1739, the supposed first introduction of the species. Lambert also figures and describes, as a distinct species, *P. microcarpa*, identical with *L. americana.* He states that cones of both species were sent annually from America to Loddiges, *P. pendula* under the name of black larch, and *P. microcarpa* as red larch; and that both kinds were growing in Loddiges's nursery.

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[1] *Act. Hort. Petrop.* xii. 98 (1892).

[2] *Larix kamtschatica*, Carr.

[3] *Floræ Manshuriæ*, i. 190 (1901).

[4] *Act. Hort. Petrop.* xii. 424 (1892).

[5] *Uttermost East*, 105 (1903).

[6] According to Loudon, *op. cit.* 2401, Solander's description was taken from the tree at Mill Hill, which, according to Lambert's figure, must have been *L. dahurica.*

Lawson's *Manual*, published in 1836, gives a careful description of both species, and repeats the information that they are natives of North America.

So far as we know *Larix dahurica* does not grow in N. America; and no traveller or botanist except Pursh ever claimed to have seen in the eastern part of the continent any species but *L. americana.* Pursh[1] asserts that *L. pendula* and *L. microcarpa* are distinct species, and were seen by him, the former growing in low cedar swamps from Canada to Jersey, the latter occurring about Hudson's Bay and on the high mountains of New York and Pennsylvania. As *L. americana* varies in the size of the cone, it seems certain that Pursh only saw forms of *L. americana.* It is very difficult to understand how seeds of *L. dahurica* from eastern Siberia could have been introduced so early.

Until about 1840 the American origin of *L. pendula* was unquestioned; and a tree planted in that year at Bayfordbury, and recorded in the planting book as *L. pendula*, is still living, and is undoubtedly *L. dahurica. Larix dahurica* was noticed first in Lawson's *Manual* as a stunted bushy tree, growing poorly, as it was propagated from cuttings or layers; and is stated to have been introduced in 1827. (A. H.)

Remarkable Trees

The finest specimen we know is figured in Plate 106, and is growing on the edge of a grassy drive at Woburn Abbey, where I first noticed its peculiar bark on the occasion of the visit of the Scottish Arboricultural Society to that place in July 1903. None of the members present could name the tree, and on comparing the foliage with the specimens at Kew I came to the conclusion that it must be a tree which is mentioned in the *Pinetum Woburnense* as *Larix pendula.* I went to Woburn again on purpose to see it in flower, on 31st March 1905, when the difference in the flowers from those of a pendulous form of the common larch growing close by was evident. But the less rugged bark, which resembles that of a cedar, is the best distinction, and is clearly shown in our illustration. It measured 86 feet high by 6 feet 7 inches in girth in 1905. I have raised a seedling from this tree.

A very similar tree is growing by the side of the entrance drive at Beauport, which from its bark and habit we believe to be of the same origin.

At Bayfordbury the tree planted in 1840 as *Larix pendula* is now 56 feet high and 5 feet in girth, with a conical stem, and bark scaling in large thin plates. European larches planted near it at the same time are 70 feet high and 5 to 6½ in girth. A tree at Denbies, near Dorking, the seat of Lord Ashcombe, was in 1903 40 feet high and 2 feet in girth. It is said to have been sent to Denbies as *Larix Griffithii* by Sir Joseph Hooker, but some mistake had evidently been made in the plant that was forwarded from Kew some forty years ago.

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[1] *Fl. Amer. Sept.* ii. 645 (1814).

In the Cambridge Botanic Garden there are two trees of this species, one 56 feet high by 5 feet in girth, in 1906. The bark scales off in smaller plates than the common larch, and shows more red-coloured cortex below. The second tree, labelled *L. pendula*, is grafted at 6 feet up on the common larch, and has its stem bent over at a right angle a few feet higher up.

At Ribston Park, Yorkshire, there is a well-grown tree of *L. dahurica* which cannot be more than about forty years old, as Major Dent remembers its being planted, though its origin is unknown. It has somewhat pendulous branches and smooth bark without ridges, and measures 71 feet by 5 feet 2 inches. It had both new and old cones on it in 1906.

There are some larches at Boynton, near Bridlington, Yorkshire, which Sir Charles Strickland has always known as red larches, and supposed to have been of American origin, but which I believe, on account of their smoother bark, to be *L. dahurica*. The best of them is 75 feet by 7 feet 8 inches; another, with a very spreading top, was 9 feet 4 inches in girth; and both had cones from which seedlings have been raised. Sir Charles Strickland has written of these in the *Gardeners' Chronicle*, 1896, pp. 399 and 494. He says that the trees which have been grown at Boynton for eighty or ninety years under the name of red and black larch are the two trees described in Loudon as varieties of *Larix americana*; and that the red larch is more like the European larch, and in loose, rather wet, sandy soil grows at Boynton as fast and to as large a size, but he does not consider the wood quite as good as that of the common larch; it is more liable to twist and warp, though probably as durable. On drier soils the red larch is much less healthy and vigorous than the common one.

At Murthly Castle there is a row of fifteen trees which were planted about 1881 by Mr. D. F. Mackenzie, who informs me that they were probably from the nursery of Messrs. B. Reid of Aberdeen, but their origin cannot now be traced with certainty. Their habit varies very much, the first one, coming from the Castle, having very pendulous branches and a weeping top, which none of the others possess. The cones also vary somewhat in size and colour, but with one exception—which I believe to be a common larch planted subsequently to replace a dead tree of the original lot—are characteristic of *L. dahurica*. The trees average 40 to 45 feet high and 3 to 4 feet in girth, and have the bark distinctly smoother and less corrugated than the bark of common larch growing under similar conditions. They are fairly healthy in appearance, with no evidence of having suffered from Peziza, but are bearing cones so freely that I do not expect they will become large trees. Mr. Mackenzie attributes this to their growing on dry, gravelly soil.

(H. J. E.)

LARIX KURILENSIS

Larix kurilensis, Mayr, *Abiet. Jap. Reiches*, 66, t. 5, f. 15 (1890), and *Fremdländ. Wald- u. Parkbäume*, 300 (1906).

Larix dahurica, Turczaninow, var. *japonica*, Maximowicz, in Regel, *Rev. Sp. Gen. Larix*, p. 59, and *Gartenflora*, xx. 105, t. 685 (1871); Miyabe, *Mem. Boston Soc. Nat. Hist.* iv. 261 (1890).

A tree, attaining in the Kurile Islands a height of 70 feet and a girth of 7 to 8 feet. Bark, according to Mayr, scarcely distinguishable from that of the Japanese larch. Young branchlets covered with a moderately dense, wavy, irregular pubescence. Branchlets of the second year shining reddish brown, pubescent. Base of the shoot girt by a ring of the previous season's bud-scales, the uppermost of which are loose and reflected, no ring of pubescence being visible; short shoots dark red, or almost black, shining. Terminal buds dark red, ovoid, with comparatively few scales, which are acuminate, non-resinous, ciliate with brown silky hairs. Lateral buds ovoid, dark red, with ciliate scales. Apical buds of the short shoots hemispherical, dark red, with no ring of pubescence at the base.

Leaves glaucous, short, broad, and curved, about an inch long, rounded at the apex, few in a bundle, usually twenty to thirty, spreading so as to form a wide open cup around the bud; upper surface flattened, green without stomata; lower surface deeply keeled, with two bands of stomata, each of five lines.

Flowers not seen. Cones small, cylindrical, about ¾ inch long, composed of few scales, less than twenty, with the bracts conspicuous at the base of the cone, but concealed elsewhere by the upper scales. Scales oval, longer than broad, about ⅓ inch long; upper margin thin, emarginate, slightly bevelled, not reflected; outer surface minutely pubescent towards the base. Bract panduriform, about half the length of the scale, terminated by a very short mucro. Seeds lying on the scale in two depressions which are separated by a membranous ridge, with the wings slightly divergent and extending up to the margin of the scale. Seed about ⅛ inch long; seed with wing about ⅓ inch long; wing broadest just above the seed.

(A. H.)

This tree was first distinguished as a species by Dr. Mayr, the distinguished dendrologist and traveller, who found it in the Kurile Islands, especially on Iturupp,[1] where it forms forests of some extent. Sargent gives an excellent illustration, plate xxvi. in the *Forest Flora of Japan*, from a photograph taken by Dr. Mayr, and I am able to show its aspect in the same island from two photographs kindly given me by the Imperial Japanese Forest Department (Plate 107). The upper shows a forest of larch on Iturupp; the lower a scattered group near the shore on the same island.

The tree was commonly planted in the neighbourhood of Sapporo, and it was introduced into Europe in 1888 by Dr. Mayr, and seems to grow almost as well as the Japanese larch, at least when young. There is a tree 15 feet high at Grafrath, the experimental forestry station near Munich, where the thermometer goes down to 15° Fahr. below zero, and seedlings only four years old are already 5½ feet high. They resembled *Larix americana* more than *L. leptolepis* in the blackish colour of their young shoots. Dr. Mayr says that it is the first larch to become green in Europe, though in my nursery seedlings of the Altai and north Russian larches are both earlier. He says that its dark shoots have gained it the name of black larch from visitors to his nursery, and that in the park of The Duke of Inn- and Knyphausen at Lütetsburg in east Friesland it grows faster than any other species of larch, being 6 metres high at the age of seven years.[1]

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[1] We adopt this spelling on Dr. Mayr's authority, as the correct Aino name for the island. Eterofu is the Japanese form of the word, and Eterop a corrupt combination of both forms of spelling.

So far as our very short experience of this tree in England enables us to judge, it is likely to thrive well, at any rate in its youth. Several young trees which are in my nursery grow fast, and ripen their growths earlier than common larch. Some seed received from Japan in June 1906 germinated very quickly, and made healthy little plants the same season. It should be tried especially in the wetter parts of Great Britain. (H. J. E.)

LARIX LEPTOLEPIS

Larix leptolepis, Endlicher,[2] *Syn. Conif.* 130 (1847); Gordon, *Pinetum*, 128 (1858); Mayr, *Abiet. Jap. Reiches*, 63, t. 5, f. 14 (1890), and *Fremdländ. Wald- u. Parkbäume*, 302 (1906); Kent, *Veitch's Man. Coniferæ*, 397 (1900).
Larix japonica, Carrière, *Conif.* 272 (1855).
Larix Kaempferi, Sargent, *Silva N. Amer.* xii. 2, adnot. 2 (1898).
Pinus Larix, Thunberg, *Fl. Jap.* 275 (1784) (not Linnæus).
Pinus Kaempferi, Lambert, *Pinus*, ii. preface, p. v (1824).
Abies Kaempferi, Lindley, *Penny Cycl.* i. 34 (1833).
Abies leptolepis, Siebold et Zuccarini, *Fl. Jap.* ii. 12, t. 105 (1842).
Pinus leptolepis, Endlicher, *Syn. Conif.* 130 (1847).

A tree attaining in Japan a height of 100 feet and a girth of 12 feet. Bark of native trees, according to Mayr, similar to that of the European larch, the freshly exfoliating scales being more brownish than red; but in cultivated trees in England the bark begins to scale very early, peeling off usually in large long strips and giving a red appearance to the trunk. Young branchlets glaucous, usually covered with a dense, erect, brown pubescence, but occasionally almost glabrous, only a few brown hairs being present. Branchlets of the second year reddish with a glaucous tinge, retaining some pubescence or quite glabrous. Base of the shoots girt by a sheath of the previous season's bud-scales, the uppermost of which are loose and reflected, with no ring of pubescence visible. Short shoots stouter than in the common larch, reddish, glabrous. Terminal buds sharply conical, resinous, glabrous, the lowermost scales subulately pointed. Lateral buds ovoid, glabrous, resinous, directed slightly forwards. Apical buds of the short shoots conical, with loose scales, surrounded at the base by a ring of pubescence.

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[1] In *Mitt. Deutsche Dendr. Ges.* 1906, p. 27, the age of this tree is stated erroneously as twenty-five to thirty years. Its height in 1906 is given as 9 metres.

[2] *Pinus leptolepis* was the name preferred by Endlicher; but he quotes *Larix leptolepis*, Hort., as a synonym; and as this is the first publication of *Larix leptolepis*, Endlicher is responsible for the name, and it is credited to him; and being the first published name under the correct genus is adopted by us. Moreover, it is the name by which this species is universally known; and the adoption of Sargent's name, *Larix Kaempferi*, would cause great confusion, as this has been used for *Pseudolarix Kaempferi*, the golden larch of China. The Japanese larch, though known to Kaempfer and Thunberg in the eighteenth century and mentioned by Lambert, was first described by Lindley in 1833.

Leaves glaucous, about 1¼ inch long, rounded at the apex; upper surface flattened, with two bands of stomata, variable in the number of lines, often two to four in each band on leaves of the long shoots, usually one to two irregular lines on leaves of the short shoots; lower surface deeply keeled, with two conspicuous bands of stomata, each of five lines.

Staminate flowers ovoid, sessile, smaller than in *L. europæa*. Pistillate flowers ovoid, pinkish; bracts all recurved, about ⅕ inch long, oblong, broadest at the base, truncate, and scarcely emarginate at the apex, brownish with pink margins, mucro about 1/20 inch long. Cones shortly ovoid, broad in proportion to their length, 1 to 1¼ inch long, readily distinguished by the thin reflected upper margins of the scales, of which there are four to five spiral rows of eight to nine in each row. Scales almost orbicular, about ⅖ inch long and wide; upper margin very thin, reflected, truncate or slightly emarginate; outer surface furrowed, slightly pubescent. Seeds in very shallow depressions on the scale, their wings slightly divergent and extending to its upper margin; seed about ⅙ inch long, with wing ⅖ inch long.

A stunted form, growing on the higher parts of Fuji-yama, was collected by John Gould Veitch, and was considered to be a new species by A. Murray;[1] and is recognised as a variety by Sargent. According to Mayr, it scarcely deserves to be ranked as a variety, as it only differs in being a low tree, with smaller cones than usual, which are only ⅗ inch in diameter and globular in shape. (A. H.)

Introduction

It was introduced by J. G. Veitch in 1861 from seeds which he procured during his visit to Japan. Nothing is said by Kent as to the number of plants raised and sent out at that time, but probably the number was small, as we know of few trees as old as forty-five years. Larger importations were made later, and the tree grew so well generally that it is now being planted almost everywhere, and some of the older trees have produced good seed for ten years or more.

Distribution

In Japan this larch grows naturally on the slopes of volcanic mountains in a sandy soil at 4000 to 6000 feet elevation, in a climate very much warmer and moister in summer, drier in winter, and less liable to late frosts than England.

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[1] *Larix japonica*, A. Murray, *Pines and Firs of Japan*, 94 (1863).
Larix leptolepis, var. *minor*, A. Murray, *Proc. Roy. Hort. Soc.* ii. 633, f. 155 (1862).
Larix leptolepis, var. *Murrayana*, Maximowicz, *Ind. Sem. Hort. Petrop.* 1866, p. 3.
Larix japonica, var. *microcarpa*, Carrière, *Conif.* 354 (1867).
Larix Kaempferi, var. *minor*, Sargent, *Silva N. Amer.* xii. 2, adnot. 2 (1898).
Abies leptolepis, Lindley, *Gard. Chron.* 1861, p. 23.

Where I first saw it, on a sandy plain above the Lake Chuzenji on the slopes of the volcano of Nantai-san, the trees were of no great size, averaging perhaps 60 to 70 feet in height, with a girth rarely exceeding 6 feet in mature trees, and more often 3 to 4 feet. They were very similar in habit to the larch in the Alps, and had not an excessive development of branches. Higher up above Yumoto in rich forest soil, thinly scattered among deciduous trees of many species, they were larger, sometimes attaining 80 feet high and 10 to 12 feet in girth; but I saw none anywhere which rivalled our larch in height, and am inclined to think it is not nearly such a long-lived tree, though, as I saw none felled, I was unable to count the rings. Prof. Sargent, who saw the tree in the same place as I did, came to a very similar conclusion. Mayr states that he found it wild on the volcanoes of central Hondo, Fuji, Ontake, Asama, Shiranesan, Norikura, and others, always growing near the timber line, with *Abies*, *Tsuga*, and *Picea hondoensis*.

The tree is valued for its timber, which is used for ship- and boat-building, and has lately come into great demand for railway sleepers and telegraph poles. In consequence of this it has been largely planted at elevations of 4000 to 5000 feet in the central and northern provinces, and many plantations that I saw of ten to fifteen years old were very similar to larch plantations in England in growth and habit. I also saw it planted experimentally in Hokkaido, along the lines of railway, where it seemed to grow as well in this rich black soil as in its native mountains.

Cultivation

In 1890 I sowed seeds from three different localities—Dunkeld, Hildenley, and Tortworth—and raised plants from each of them, which grew better than seedlings raised at the same time from Japanese seed; but this may have been partly due to the fact that the latter were dressed with paraffin by my forester to protect them from birds and mice in the seed-bed. At six years old these plants are now from four to eight feet high, and though some of them have been more or less checked by severe spring frosts, they are generally growing well.

As a proof of the hardiness of the tree I may mention that the late Sir R. Menzies showed me three young trees which he had planted, at an elevation of about 1250 feet, in the garden of the inn near the top of the pass between Glen Lyon and Loch Rannoch; and in some of his plantations on the north shore of Loch Rannoch they were growing very vigorously in mixture with Douglas fir.

No conifer of recent introduction has attracted so much attention among foresters as the Japanese larch, which, during the last ten years, has been sown very largely by nurserymen (Messrs. Dickson of Chester are said to have sold no less than 750,000 in the year 1905), and is looked upon by many foresters as likely to replace the common larch, because it is, so far as we yet know, less liable to the attacks of *Peziza Willkommii*. But this pest has already in more than one place been certainly identified on the Japanese larch, and I have little doubt that as time goes on we shall hear more of this. Henry visited in 1904 six plantations of Japanese larch of ages from five to sixteen years, and in none could detect any sign of canker. There were plantations of European larch in every case adjoining those of the Japanese tree, and the former were all badly affected by disease. Henry concluded that the Japanese larch was practically immune from disease, though on his return to Kew he received specimens from estates in Perthshire and Dumfriesshire which were undoubtedly suffering from Peziza.[1] As, with the exception of Prof. Sargent and Dr. Mayr, no one had studied this tree in its native climate, I paid particular attention to it during my visit to Japan in 1904, and, as I have stated[2] elsewhere, came away with the impression that it is not likely to supersede the European larch as a forest tree, and am very doubtful whether it can be expected to become a profitable one, to plant under ordinary conditions. Though when young its growth is extremely rapid and vigorous, it has a great tendency to form spreading branches, and even in the much more favourable soil and climate of Japan, rarely, if ever, attains anything like the dimensions which the European larch does in Great Britain.

Mayr's opinion on the suitability of the tree for economic plantations in Europe is the same as my own, and he considers that though it may grow faster than the European larch for the first twenty years, yet that it will eventually be surpassed if planted under precisely similar conditions. He also agrees with me that though in selected positions and under careful cultivation it may not seem so liable as the European larch to the attacks of Peziza, yet that it is not immune, and the figures which he gives of its growth in Germany show that it has the same tendency to produce spreading branches there as in Great Britain. In a note on this tree by K. Kumé, chief of the Forestry Bureau in Japan, in *Trans. Scot. Arb. Soc.* xx. 28, January 1907, a yield table at various ages is given, which shows that on soils of medium quality in Japan the mean basal diameter at 100 years old is about a foot, the mean height 92 feet, and the stem volume per acre 6330 cubic feet. I will only note that what is meant by land of medium quality in Japan is very superior to what it is in this country. In Germany Mayr says that the seed falls in autumn from the cones, which are busily sought for by squirrels, and that self-sown seed has germinated freely at Grafrath under trees twenty-two years old.

REMARKABLE TREES

There are many specimens now of about 40 feet high in various parts of the country, but of those that I have seen the one figured, which is growing at Tortworth (Plate 108), is perhaps the finest. It measured in 1904, 45 feet by 4 feet 7 inches, and was covered with cones. It is growing on red sandy soil, and Lord Ducie thinks it is one of the earliest introductions. At Hollycombe, Sussex, the seat of J. C. Hawkshaw, Esq., Mr. G. Marshall measured a tree 45 feet by 2 feet 4 inches in 1904. At Hildenley, Yorkshire, there is a fine tree about 40 feet high, which produces good seed. A clump of fine trees is reported[3] to be growing at Bothalhaugh, near Morpeth. There is also a fine specimen at Brook House, Haywards Heath, the residence of Mrs. Stephenson Clarke.

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[1] See note by Mr. Massee in *Journ. Board Agriculture*, 501 (1904).

[2] *Trans. Scot. Arb. Soc.* xix. 77 (1906).

[3] *Gard. Chron.* xxxix. 282 (1906).

At Dunkeld there is a tree planted close to a common larch, from which seedlings were raised at my suggestion by the late D. Keir, which appear to be hybrids between the two species.[1] His son, who succeeded him as forester to the Duke of Atholl, and who has watched the growth of these seedlings, considers them to be intermediate between the two species; but it is yet too soon to be certain.

At Abercairney, Perthshire, the seat of Col. Drummond Moray, there is a tree, raised from seed brought from Japan in 1883, which, measured by Henry in 1904, was 38 feet by 3 feet 5 inches. At Blair Drummond, in the same county, he measured ten trees planted in 1888, one of which was 44 feet high, and the average girth 2 feet 5 inches. They were all healthy though growing among common larch which was diseased.

At Cullen House, Banffshire, Mr. Campbell tells me that there is a tree 45 feet by 3½ feet. At Kirkennan, near Dalbeattie, Kircudbrightshire, two larches sown in 1885 were in 1904 41 feet by 2 feet and 35 feet by 1 foot 11 inches. We are indebted for this information to the owner Mr. W. Maxwell.

In Germany at Schloss Lütetsburg, it seems to have grown faster than with us, for it is stated[2] that trees thirty-five to forty years old are 17 to 20 metres high, with a girth at 1 metre of 1.80 to 2.70 metres. (H. J. E.)

LARIX GRIFFITHII, SIKKIM LARCH

Larix Griffithii, J. D. Hooker, *Ill. Himal. Pl.* t. 21 (excl. ff. 1-4) (1855), *Flora Br. India*, v. 655 (1888), and *Gard. Chron.* xxv. 718, f. 157 (1886); Masters, *Gard. Chron.* xxvi. 464, f. 95 (1886); Kent, *Veitch's Man. Coniferæ*, 395 (1900); Gamble, *Indian Timbers*, 720 (1902).

Larix Griffithiana, Carrière, *Conif.* 278 (1855).

Abies Griffithiana, Lindley and Gordon, *Journ. Hort. Soc.* v. 214 (1850).

Pinus Griffithii, Parlatore, DC. *Prod.* xvi. 2, p. 411 (1864).

A tree, attaining in the Himalayas about 60 feet in height, with thick brown bark, and wide-spreading, long and pendulous branches.

Young branchlets, reddish, covered with a dense wavy, more or less appressed pubescence, and girt at the base by a sheath of the previous season's bud-scales, the uppermost of which are very broad, loose, membranous, and reflected. Branchlets of the second year very stout, dull reddish brown, pubescent. Short shoots broad and stout, fringed above by very large, loose, reflected, pubescent, membranous bud-scales. Terminal buds broadly conical, non-resinous, with pubescent scales. Lateral buds ovoid, pointing outwards and forwards, non-resinous, pubescent. Apical buds of the short shoots conical, with loose pubescent scales.

Leaves light green in colour, about 1¼ inch long, ending in a short rounded point; upper surface rounded or flat, with one or two broken lines of stomata near the apex; lower surface deeply keeled with two bands of stomata, each of three

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[1] Cf. *Trans. Roy. Scot. Arbor. Soc.* xviii. 62 (1905).

[2] *Mitt. Deutsche Dend. Ges.* 1906, p. 29.

(occasionally five) lines. In cultivated specimens, the leaves are fringed on each side with a very thin and narrow membranous translucent border.

Staminate flowers, $\frac{3}{8}$ inch long, cylindrical, raised on short stout stalks, about $\frac{1}{16}$ inch long. Pistillate flowers ovoid; bracts reflected at their bases, with the mucros pointing downwards, oblong, truncate or slightly concave at the apex, the green midrib being prolonged into a mucro about $\frac{1}{6}$ inch long.

Cones 3 to 4 inches long, cylindrical, tapering to a narrow, flattened apex, supported on a short stalk, glaucous green or purplish, with orange-brown bracts before ripening, composed of five spiral rows of scales, eighteen to twenty scales in each row, which, on the opening of the cone, stand almost at right angles to its axis, the bracts being exserted with their mucros directed upwards. Scales quadrangular, with a cuneate base, about $\frac{1}{2}$ inch in width and length; upper margin truncate and slightly emarginate; outer surface radially furrowed, densely pubescent towards the base. Bract lanceolate, nearly as long or quite as long as the scale, the mucro, often incurved, projecting beyond the scale about $\frac{3}{16}$ inch. Seeds lying in slight depressions on the scale, their wings widely divergent and not extending to its upper margin. Seed, white on the inner side, shining dark brown on the outer side, about $\frac{1}{6}$ inch long; seed with wing about $\frac{7}{16}$ inch long; wing brownish, rather opaque, broadest about the middle. Cotyledons[1] five to six, which, in the seedling, are linear, pointed, and much longer than the succeeding leaves. (A. H.)

The Sikkim larch is confined, so far as we know at present, to a rather narrow area in the Himalaya, from eastern Nepal to Bhutan, but very possibly will be found farther east. It was discovered by Griffith, but not distinguished until Sir Joseph Hooker found it in E. Nepal in December 1848.[2] Here it was only a small tree 20 to 40 feet high, differing from the European larch, in having very long, pensile, whip-like branches. It is called "Saar" by the Lepchas, and "Boargasella" by the Nepalese, who said that it was only found as far west as the sources of the Cosi river. In Sikkim it is common in the interior valleys of the Lachen, Lachoong, and their tributaries from about 8000 to 12,000 feet elevation, and here attains a larger size, but is not found in the forests of British Sikkim. In *Illustrations of Himalayan Plants from Drawings by Cathcart*, where it is beautifully figured, Sir Joseph states that it grows to a height of 60 feet in deep valleys, but prefers the dry rocky ancient moraines formed by glaciers, and also grows on grassy slopes where the drainage is good. On my journey to Tibet in 1870 I saw this tree in the Lachoong valley, but nowhere forming a forest, and usually scattered singly in rather open places, where it seemed to me to have a much less erect and regular growth, with branches more drooping in habit than any other larch. Sir Joseph Hooker says that the wood is soft and white, but a specimen from the Chumbi valley, authenticated by cones, is described by Gamble as having red heart-wood with a slow growth, twenty-one rings to the inch, and a weight of 32 lbs. to the foot.

Though introduced by Sir Joseph Hooker, who sent seeds to Kew in 1848, this tree has, except in a few places in the south-west of England, failed to grow in Europe. He says that the seedlings raised from his seeds were 3 to 4 feet high in

[1] Masters, *loc cit.*

[2] *Himalayan Journals*, i. 255.

1855, and that some had withstood the severe winter of 1854-5 without protection, though others were killed, a difference which he attributes to some of the seed having been gathered from trees which grew at 8000 and some from trees at nearly 13,000 feet. Hooker[1] further states that hundreds of plants were raised and widely distributed by Kew, but in every case these succumbed in a few years to virulent attacks of *Coccus laricis*. As the climate of the Chumbi valley is much drier than that of Sikkim, it is quite possible that seed from that locality would give better results; but I have never been able to keep the tree alive at Colesborne for long, as it suffers from the dry climate, and seems to object to lime in the soil. Mr. Barrie, forester to the Hon. Mark Rolle, has been very successful in growing this tree from English-grown seed, and has sent me healthy young plants of it; but the seedlings I have raised at Colesborne both from imported and home-grown seed have always died, though protected by a frame.

REMARKABLE TREES

The largest specimen of the Sikkim larch we know of in this country is one at Coldrinick, near Menheniot, Cornwall, the seat of Major-Gen. Jago-Trelawney. I have not seen this tree, but the gardener, Mr. Skin, informs me that in 1905 it measured no less than 57 feet by 4 feet 6 inches in girth. It has very spreading branches, the width from point to point of the lowermost branches being 43 feet. The cones were admirably figured in the *Gardeners' Chronicle*,[2] and have produced fertile seed. The seedlings require careful treatment, as they easily "damp off."

A tree of the original introduction is growing at Strete Raleigh, Devonshire, the seat of H. M. Imbert Terry, Esq., who showed it to me in 1903, when it measured 40 feet high by 4 feet in girth. It is growing on poorish soil at a considerable elevation, where it is a good deal exposed to the damp south-west winds, and perhaps in consequence of this has thriven very well, and has borne fertile seed for some years past (Plate 109).

Another much smaller tree, which also bears cones, is growing at Leonardslee in Sussex. There is also an old tree at Pencarrow, in Cornwall, which in 1905 was only 12 feet high by 15 inches in girth, stunted and covered with lichen. It also bears cones.

Dr. Masters[3] received flowering specimens in 1896 from The Frythe, Welwyn, Herts; but the tree from which they were obtained could not be found when Henry visited this place in 1906. (H. J. E.)

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[1] *Gard. Chron.*, *loc. cit.*

[2] After this was printed a good illustration of the tree appeared in the same journal on 2nd March 1907, which shows that it is not only larger, but a better shaped tree than the one I have figured.

[3] *Gard. Chron.* xxvii. 296 (1900).

LARIX POTANINI, CHINESE LARCH

Larix Potanini, Batalin, *Act. Hort. Petrop.* xiii. 385 (1894); Masters, *Gard. Chron.* xxxix. 178, f. 68 (1906).
Larix thibetica, Franchet, *Jour. de Bot.* 1899, p. 262.
Larix Griffithii, Masters, *Jour. Linn. Soc.* (*Bot.*) xxvi. 558 (1902). (Not Hooker.)

A tree attaining in western China a height of 70 feet and a girth of 6 feet. Young branchlets bright yellow, with a scattered pubescence, densest near the base of the shoot, which is girt by a sheath of the previous season's bud-scales, showing within a ring of pubescence. Buds ovoid, with ciliate scales.

Leaves slender, up to an inch in length, ending in a sharp cartilaginous point, tetragonal in section, keeled above and below, with two bands of stomata, each of two lines, on both the upper and lower surfaces.

Staminate flowers, ¼ inch long, on a short but distinct stalk. Pistillate flowers ovoid, narrow and rounded at the apex; bracts closely appressed, on one side of the young cone with their tips pointing towards its apex, on the other side reflected about their middle with their apices pointing towards the base of the cone, ovate or oblong, rounded and entire at the apex, which is prolonged into a short mucro. The bracts in the pistillate flower, described above as seen in herbarium specimens, are probably all reflected at first; and gradually by the growth of the scale assume the erect position.

Cones cylindrical, rounded at the apex, 1¾ inch long, with the scales and bracts pointing upwards and outwards, or more or less spreading. Scales small, about ⅓ inch long, almost orbicular, reddish brown, pubescent on the lower part of the outer surface; upper margin rounded or truncate, entire, thin, slightly inflected, not bevelled. Bract extending beyond the scale, exserted with the mucro about ¼ inch. Seeds in slight depressions on the scale, with their wings widely divergent and not reaching to its upper margin. Seed about ⅛ inch long; seed with wing ⅓ inch long; wing broadest just above the seed.

Larix Potanini has been collected in western China by Potanin, Prince Henry of Orleans, Pratt, and Wilson, who found it in the neighbourhood of the Szechuan-Thibetan frontier near Tachienlu at 7500 to 11,000 feet above sea-level. The same species, according to Franchet, was probably collected by Père Delavay farther south on the Likiang range in Yunnan at 11,600 feet altitude. Mr. A. Hosie, Consul-General in Szechuan, informs me that forty miles north-east of Tachienlu, there is a pure forest of this larch between 11,000 and 12,000 feet elevation on the southern slope of the mountain range, and extending for about a mile. It consists of fine straight trees, which he estimated to be about 70 feet high. At lower altitudes the larch gives place to silver fir and birch. The tree is known to the Chinese as "hung-sha," red fir, and produces the most valuable coniferous timber in western China.

Seed was collected by Wilson in 1904, and plants have been raised, which are growing well at Veitch's nursery, Coombe Wood.

This species, being a purely alpine tree of no great size, will probably be of no value as a forest tree, resembling in that respect its immediate allies *L. Griffithii* and *L. Lyallii*, between which it occupies an intermediate position as regards botanical characters. (A. H.)

LARIX AMERICANA, Tamarack

Larix americana, Michaux, *Fl. Bor. Am.* ii. 203 (1803); Sargent, *Silva N. Am.* xii. 7, t. 593 (1898), and *Trees N. Am.* 35 (1905); Kent, *Veitch's Man. Conif.* 389 (1900).
Larix americana, Michaux, var. *rubra*, Loudon, *Arb. et Frut. Brit.* iv. 2400 (1838).
Larix tenuifolia, Salisbury, *Trans. Linn. Soc.* viii. 314 (1807).
Larix microcarpa, Desfontaines, *Hist. Arb.* ii. 597 (1809); Lawson, *Agric. Man.* 388 (1836).
Larix laricina, Koch, *Dendrologie*, II. ii. 263 (1873).
Larix pendula, Masters, *Journ. Roy. Hort. Soc.* xiv. 218 (1892). (Not Salisbury.)
Pinus Larix americana nigra, Muenchausen, *Hausv.* v. 226 (1770).
Pinus laricina, Du Roi, *Obs. Bot.* 49 (1771).
Pinus intermedia, Wangenheim, *Beit. Hölz. Forst. Nord Am. Hölz.* 42, t. 16, f. 37 (1787).
Pinus microcarpa, Lambert, *Pinus*, i. 58, t. 37 (1803).
Abies microcarpa, Poiret, *Lamarck's Dict.* vi. 514 (1804).

A tree attaining in America about 80 feet in height and 6 feet in girth. Bark separating in thin small polygonal or roundish scales about an inch in diameter, which are closely appressed, and show when they fall off the reddish cortex beneath. Young branchlets slender, often glaucous, glabrous, or with a few scattered hairs in the grooves between the pulvini; older branchlets glabrous, shining brown. Base of the shoot girt with a short sheath of the previous season's bud-scales, no ring of pubescence being visible. Short shoots small, blackish, glabrous. Terminal buds globose, slightly resinous, glabrous, with the basal scales subulately pointed. Lateral buds hemispherical, resinous, dark brown. Apical buds of the short shoots broadly conical, surrounded at the base by a ring of brown pubescence.

Leaves short and slender, not exceeding 1¼ inch in length, rounded at the apex, light green; upper surface flat or rounded, without stomata, except two broken lines near the tip; lower surface deeply keeled with two bands of stomata, each of one to two lines.

Staminate flowers sessile, shorter than in *L. europæa.* Pistillate flowers ovoid, reddish, very small; bracts pointing upwards and outwards, not reflected or recurved, ⅛ to ⅙ inch long, oblong, scarcely emarginate at the apex, reddish with a green midrib and mucro, the latter cuspidate and very short, about 1/30 inch long.

Cones small, globose, consisting of three to four spiral rows of five scales each, reddish brown when ripe, ½ to ⅔ inch long. Scales gaping widely at the apex of the cone, longer than broad, about ⅖ inch long; upper margin rounded, bevelled, slightly crenulate, not recurved or reflected. Bract concealed, minute, about ⅙ inch long.

Seeds lying on the scale in minute depressions, with their wings only slightly divergent and not reaching to its upper margin, $\frac{1}{7}$ inch long; wing $\frac{1}{3}$ inch long, broadest just above the seed. (A. H.)

DISTRIBUTION

The American larch is found in the United States from North Pennsylvania, Northern Indiana and Illinois, and Central Minnesota through the New England States, where, however, it is only found in cold and swampy places. In Newfoundland, Labrador, and the eastern provinces of Canada it occupies swampy ground, and extends from York Factory on Hudson Bay as far as Fort Churchill, 67° 30′ N., and west to Athabasca and Peace river districts, and in Alberta where it has been found forty miles S.W. of Edmonton.[1] Northwards it extends to the border of the barren lands. Mr. J. M. Macoun informs me that it was found by Mr. Camsell in the angle between the Snake river and the upper part of Peel river. This place is just within the Yukon district. He also states that it extends westward twenty-two miles up the Dease river, and northward along the upper Liard river to lat. 61° 30′. He has heard several people who have been on the Yukon speak of the larch, so that it must be quite common in some parts, though no definite data are as yet given.

The tamarack, as it is called in most parts of N. America, is a tree which I know but little in a state of nature, and which never seems to have received the attention from foresters which it deserves; for though it nowhere attains the size of the common larch, it seems able to thrive in undrained and swampy ground where that would die; and though a slow-growing tree in comparison with the common larch, its timber has the same valuable qualities as others of the genus.

Henry saw this species in Minnesota in 1906. On the Cass Lake Forest Reserve it occurs in the swampy ground between the pine-covered sand-dunes, in company with balsam fir, Thuya, black and white spruce, birch, and willow. The largest that he saw measured 81 feet by 4 feet 7 inches. The trees are remarkable for their buttressed roots, which branch and extend close to the surface and even above ground for as much as 6 feet. Seedlings were numerous in felled areas near Erskine, where the larch remaining uncut, occurs in swamps either pure or mixed only with birch. They grow very rapidly in the wet ground, taking root in mossy elevated patches and not in the water of the swamps; and averaged 10 feet high at seven years old, and were making leaders of 1 to 2 feet annually. He saw no stumps larger than 2 feet in diameter, and the tree in Minnesota rarely attains a greater size than 80 feet by 6 feet. In *Garden and Forest*, 1890, p. 60, there is, however, mention of a tamarack in Minnesota, which measured 7 feet 8 inches in girth and was estimated at 125 feet high.

In most parts of New England and over the greater part of British North America the tamarack is a well-known tree, but rarely attains any great size. The average in the neighbourhood of Ottawa is not over 50 to 60 feet, but when the tree is planted on drier, better land it will grow faster and attain 80 feet or more. I noticed that though it seeds freely the seedlings require more light than those of the spruce, balsam fir, and Thuya, which often grow with it, and it was only where clearings had been made, or in wet places on the edge of the groves, that they seemed able to thrive. Their growth is slow at first, but when established may be as much as two feet annually.

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[1] Bell in *Scottish Geogr. Mag.* xiii. 283.

Dr. Bell gives the probable life of the white spruce in Canada as from 100 to 140 years, that of the black spruce 150 to 175 years, and that of tamarack 175 or 200 years. Of the latter he says:[1] About 1893 or 1894 the imported sawfly[2] came up from the direction of New York and got into the forests north of the Ottawa river. In a year or two it reached James bay and killed the tamarack throughout that district, which was only able to live three or four years after it was first attacked by the larva. This destruction continued to spread to the centre of Labrador, and now it has gone pretty well all over that great peninsula. But Mr. J. C. Langelier (*loc. cit.* p. 65), speaking of the same attack in the northern part of the province of Quebec, says that a great portion of the young trees were spared, and that the dead trees which remain standing are not attacked by rot, and would supply excellent railway ties.

REMARKABLE TREES

In this country there are not many large trees of this species, though it was introduced, according to Loudon,[3] by the Duke of Argyll in 1760 at Whitton, near Hounslow. It has been entirely neglected by modern arboriculturists, and is seldom or never procurable in English nurseries. The largest trees that I know of are at Dropmore, where there is a well-grown tree 78 feet by 5 feet (Plate 110), and at Arley Castle, where there are three trees of nearly the same size standing together, of which the best measures 71 feet by 4 feet 8 inches. A fourth is nearly as large, and differs in having larger cones.

At Boynton, Yorkshire, there are two in a wet situation among other trees, about 50 feet high and sixty years old, which were raised by Sir Charles Strickland from seed produced by trees planted by his grandfather. These again have produced fertile seeds, from which seedlings are growing vigorously in a low frosty situation at Colesborne, and have never suffered from frost or bug, though one of them in 1906 was attacked by Peziza. Sir Charles adds that on dry soil they have grown very badly.

At Beauport there are three rather stunted specimens of American larch, one of which, however, is 5 feet 10 inches in girth, and has the bark very smooth in comparison with the common larch. No specimen seems to have been sent to the Conifer Conference, but one is mentioned as growing in the grounds of Dalkeith Palace,[4] which we have identified with *L. dahurica*. Several trees mentioned by Loudon are either not now in existence or were not correctly named.

(H. J. E.)

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[1] *Can. For. Ass. Annual Report*, 1905, p. 59.

[2] According to Sargent this is *Nematus Erichsonii*, Hartig, a European insect which was not much noticed in America before 1880, and which has recently attacked the larch in England. Cf. *supra*, p. 364.

[3] *Op. cit.* 2400, 2401. The original tree at Whitton was between 40 and 50 feet high in 1837: it has long since been cut down.

[4] *Veitch's Man. Coniferæ*, 390 note (1900).

LARIX OCCIDENTALIS, Western Larch

Larix occidentalis, Nuttall, *Sylva*, iii. 143, t. 120 (1849); Lyall, *Journ. Linn. Soc.* vii. 143 (1864); Sargent, *Gard. Chron.* xxv. 652, f. 145 (1886), *Silva N. Amer.* xii. 11, t. 594 (1898), and *Trees N. Amer.* 36 (1905); Kent, *Veitch's Man. Coniferæ*, 400 (1900); Mayr, *Fremdländ. Wald- u. Parkbäume*, 306 (1906).

Pinus Nuttalli, Parlatore, DC. *Prod.* xvi. 2, p. 412 (1868).

A tree attaining in America 200 feet in height and over 20 feet in girth; narrowly pyramidal in habit, the branches being much shorter than in the other species. Bark of young stems thin, dark-coloured, and scaly; becoming near the base of old trunks 6 inches thick and breaking into irregularly shaped oblong plates, often 2 feet in length and covered with thin reddish scales. Young branchlets covered with a minute dense pubescence intermixed with longer hairs in the grooves between the pulvini. In certain cultivated specimens the branchlets are glabrous from the first. Branchlets of the second year light brown, shining. Base of the shoot girt with a sheath of the previous season's bud-scales, no ring of pubescence being visible. Short shoots chestnut brown, shining. Terminal buds globose, with pubescent and ciliate scales, the lowermost of which are subulately pointed. Lateral buds hemispherical with pubescent and ciliate scales. Apical buds of the short shoots broadly conical, reddish brown, pubescent.

Leaves light green in colour, up to 1¾ inch long, rounded on the back, deeply keeled beneath, with stomatic lines as in *L. europæa.*

Staminate flowers raised on short stalks at maturity. Pistillate flowers ovoid; the bracts pointing upwards and outwards and not recurved, ¼ inch long, brownish in colour with a green midrib and mucro, oblong, emarginate at the apex; mucro ⅒ inch long.

Cones ovoid, 1¼ to 2 inches long, with the bracts long-exserted and the scales opening early in the season to let out the seeds and then standing at right angles to the axis of the cone. Scales in six spiral rows, each row of nine to ten scales; orbicular, ⅓ to ½ inch long; upper margin entire or emarginate, thin, slightly recurved, not bevelled; outer surface densely pubescent. Bracts ovate-lanceolate, extending up to near the margin of the scale, beyond which the mucro projects ⅛ to ½ inch. Seeds lying in two deep depressions on the scale, their wings narrowly divergent and extending up to its upper margin; body of the seed ⅛ inch long; wing pale coloured, short and broad, widest at the base; seed with wing ¼ to ⅜ inch long.

Varieties

In the wild state the tree shows little variation, except in the pubescence of the branchlets, which in rare cases is entirely absent; while in other cases, noticed occasionally at high elevations, the amount of pubescence becomes so dense as to be almost similar in character to the tomentum of *Larix Lyallii.* In the few cultivated trees in England, two distinct forms are apparent. Certain trees have pubescent branchlets and bear large cones, up to two inches in length, which have large scales purplish in colour before ripening, long exserted bracts and long-winged seeds. Other trees with glabrous branchlets bear small cones, about 1¼ inch in length, with scales green before ripening, shorter exserted bracts and small seeds with short wings. The former trees are more narrowly pyramidal in habit.

HISTORY

This splendid tree is the largest of the genus, and though it has been known to botanists for many years, it was till quite recently, on account of its being neglected by the early explorers of the limited region which it inhabits, one of the rarest exotic conifers in cultivation.

It was first discovered by David Douglas[1] in 1826 near Fort Colville on the Upper Columbia river; but was mistaken by him for the European larch. His specimens in the Kew Herbarium are labelled "in aqueous flats on the mountain valleys near Kettle Falls and in the Rocky Mountains, 1826." The tree was first described in 1849 by Nuttall, who found it on the Blue Mountains of Oregon in 1834.

It was introduced into cultivation in the Arnold Arboretum in 1881, seedlings having been imported from Oregon; but in the climate of New England these have remained small and stunted, though branches grafted on the Japanese larch have grown vigorously. Forty plants were sent from the Arnold Arboretum to Kew in 1881, and one tree survives (the fate of the other plants being unknown), which is remarkable for its beautiful straight stem and narrow, almost columnar habit. This tree bears large purplish cones, and is now (1906) 33 feet in height and 17 inches in girth.

Ten plants were subsequently sent in 1889 from the Arnold Arboretum to Kew, of which two survive. One of these trees is, however, identical in cones and pubescent branchlets with the tree of 1881, and may be erroneously labelled 1889; it has suffered damage at the top. The other tree, which has glabrous branchlets and bears small green cones, is not quite so narrow in habit, and measured in 1906 29 feet in height and 17½ inches in girth.

The only other large tree in Britain with which we are acquainted is growing at Grayswood Hill, Haslemere; and measured in 1906 28 feet high by 19 inches in girth. It has pubescent branchlets, and bears purple cones, which are, however, smaller than those of the Kew tree, labelled 1881. Mr. Chambers informs us that this tree was obtained from Messrs. Dickson of Chester in 1889.

DISTRIBUTION

The western larch is confined to the more humid parts of the region, which extends from the western slope of the Rocky Mountains in British Columbia and

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[1] *Comp. Bot. Mag.* ii. 109 (1836), where Douglas states that he measured trees 30 feet in girth.

Montana to the eastern slope of the Cascade Mountains in Washington and Oregon.

In British Columbia it is abundant and large in the Kootenay and Columbia river valleys, reaching as far north as the head of Upper Columbia lake, and attaining its most westerly point, where it was found by Prof. Dawson, in long. 124° E., on a tributary of the Blackwater river. It grows sparingly about the Shuswap lake and in the Coldstream valley near the head of Okanagan lake.

The tree, however, attains its greatest development in Montana, where it is abundant and constitutes a great part of the timber of the Flathead, Lewis and Clarke, and Bitter Root Forest Reserves; and is met with east of Missoula on the Big Blackfoot river. The tree can be most conveniently seen by the traveller on different points of the Great Northern Railway between Nyack and Bonner's Ferry. It attains also great perfection in Northern Idaho and North-East Washington, where it constitutes an important part of the timber of the Priest River Forest Reserve. It also occurs in Oregon, in the Blue Mountains, and on the foothills of the eastern side of the Cascade Mountains,[1] as far south as Mount Jefferson.

The western larch occurs between 2500 and 6000 feet altitude; and attains its maximum height and is most abundant in mountain valleys and on alluvial flats, where the average elevation is 3000 to 3500 feet. On the sides of the mountains, owing to the lack of moisture in the soil, it rapidly diminishes in size and vigour. It requires a wetter soil than either *Pinus ponderosa* or Douglas fir, and is restricted in its distribution where the rainfall is slight.

With regard to the opinion, prevalent even in America, that it grows in a semi-arid climate, my experience is entirely different. The meteorological stations are almost invariably in towns in the prairie regions, where the rainfall is small and trees only occur on the banks of streams; and the maps and statistics of the rainfall give on that account an imperfect picture of the climatic conditions which prevail in the forest regions between the Cascades and the Rocky Mountains. At Kalispell in the Flathead country, which is situated in a treeless plain, surrounded by densely forested mountains, the annual rainfall varies from 13 to 19 inches; whereas at Columbia Falls, placed on the edge of the plain and amidst the larch forests, the rainfall increases to from 20 to 29 inches; and in the mountain valleys, as at Lake Macdonald and Swan Lake, where *Thuya plicata* attains a large size, the rainfall must exceed 30 inches. The meteorological data of Columbia Falls, which is at 3100 feet elevation, give a fair idea of the climate in which *Larix occidentalis* thrives, though it is scarcely here at its best. The figures for 1905, which was a dry year, are:—

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[1] Mr. Cohoon, Forest Assistant in the Northern Division of the Cascade Forest Reserve, wrote to me in 1906 as follows: "The only locality in which larch came under my observation in the reserve was on the east slope of the Cascade Mountains about 15 miles west of Durfur, Oregon. It did not occur abundantly, but was more or less scattered, in mixture with yellow pine, red fir, and lodge-pole pine. It was found on moist but well-drained soil at an altitude of about 2500 to 3000 feet." He adds that he never saw it west of the summit of the Cascades, which he has travelled over from Columbia river to California.

At Bridal Veil, Oregon, and other places on the Pacific slope, the term larch is erroneously applied to *Abies nobilis*.

	Precipitation in Inches.		Min. Temp.	Max. Temp.	Mean Temp.
	Snow.	Rain.	Fahr.	Fahr.	Fahr.
January	2.14	...	−1°	46°	24°
February	0.93	...	−35°	52°	18°
March	0.34	...	14°	63°	38°
April	...	0.45	15°	76°	44°
May	...	3.13	20°	83°	49°
June	...	2.23	28°	89°	56°
July	...	0.38	34°	96°	65°
August	...	0.12	29°	96°	64°
September	...	2.04	24°	83°	55°
October	...	2.54	9°	60°	38°
November	2.47	...	−11°	56°	30°
December	2.79	...	3°	46°	25°
Total precipitation, 1905	19.56 inches.				

Average precipitation for ten years 21.70 inches.

Rain or snow fell on 76 days; 91 days were cloudy; 49 days were partially cloudy; and the sky was clear on 149 days.

The above figures show that the climate is an extreme one, the winter season being cold and severe and lasting five months, while in summer a high temperature is often reached.

The western larch grows usually mixed with other conifers; and the number of accompanying species and the proportions of the admixture are very variable, being dependent on the climate and altitude, and on the quantity of moisture in the soil. Douglas fir is the most common companion of the larch, and *Pinus ponderosa* steps in where the soil is dry. Engelmann's spruce and *Abies lasiocarpa* descend into the larch forests, but never constitute any large element of it. *Pinus monticola*, *Tsuga albertiana*, and *Abies grandis* are often met with in small quantity at low altitudes in the larch forests of Montana; farther west, in the Priest River Forest Reserve, *Pinus monticola* is more abundant than the larch itself between 2400 and 4800 feet. *Thuya plicata*, in regions with a moist climate, forms a notable part of certain larch stands, often to the exclusion of the other species which usually accompany the larch.

The following notes on a few of the larch forests visited by me will illustrate some different types in Montana.

Near Missoula, in Pattie Cañon, which is a very dry valley at 3500 feet elevation in a rather arid climate, the larch only grows on the cool northern aspect, and is mixed with Douglas fir and *Pinus ponderosa*. An acre contained, of trees over a foot in diameter, twenty larches, four firs, and three pines. An average good larch tree measured 143 feet by 9 feet 7 inches; and a tree which we cut down, 14 inches in diameter, showed 211 annual rings, the sapwood being 1¼ inch in thickness and containing thirty-one rings.

On the southern end of Lake Macdonald, at 3500 feet altitude in a humid climate, I saw a fine stand composed almost exclusively of larch and *Thuya plicata*. The soil was glacial clay, very deep, and covered with a thick layer of humus. The

Thuya only attained about 110 by 7 feet, and had been overtopped by the larch, which ran from 140 to 150 feet high, and 7 to 14 in girth. The trees were extremely dense upon the ground, standing often only 12 feet apart, and averaging 200 to the acre. The ground was covered with seedlings of Thuya, 3 to 6 feet high, and more than thirty years old. The Thuya trees were being felled for telegraph and telephone poles, but never had clean stems, being covered with dead branches to 6 to 20 feet above the ground, and with living branches above this, and when of a large size were always decayed at the heart. The larch, as usual, was quite sound.

A wood near Whitefish, on flat land in a moderately rainy district at 3000 feet altitude, was composed of about nine-tenths larch and one-tenth Douglas fir, *Pinus ponderosa*, and Engelmann's spruce. The larch were 160 feet high by 6 to 9 feet in girth, overtopping the other trees, and with clean stems up to 80 or 90 feet. A stump, 40 inches in diameter, showed 585 annual rings, the sapwood with forty-two rings being only an inch in thickness, and the bark two inches.

The largest tree which I saw was growing on a high bank beside the Stillwater Creek, some miles west of Whitefish. It measured 19 feet 4 inches in girth at 5 feet from the ground, but the top was blown off. Near it were many large trees, 12 feet to 15 feet in girth, but the tallest was only 151 feet in height.

With regard to the height attained by the western larch, Sargent in his *Report on the Forest Trees of North America*, 216 (1884), states that it ranges from 100 to 150 feet, but in the *Silva* he gives the maximum height as 250 feet. I could find no confirmation of the latter figure either at the Arnold Arboretum or Washington, and I am of opinion that 180 feet is rarely if ever exceeded. The tallest tree recorded by any accurate observer is, I believe, the one cut down by Ayres[1] in the Whitefish Valley at 3500 feet altitude, which measured 181 feet high, with a diameter of 3 feet on the stump, and scaled 3500 feet board measure. He mentions[1] also another tree growing on the middle fork of the Flathead river, which was 180 feet high by 4 feet in diameter.

J. B. Leiberg states in his account of the Priest River Forest Reserve that the larch in the sub-alpine zone, above 4800 feet elevation, averaged 60 to 100 feet in height, 1 to 2 feet in diameter, and eighty to a hundred years old; while in the white pine zone, from 2400 to 4800 feet, the trees were 150 to 200 feet in height, 2 to 4 feet in diameter, and 175 to 420 years old. Here the heights are evidently estimates, and cannot be relied on implicitly.

The western larch is rarely seen as pure forest, and then only as the result of forest fires. Mr. Langille in his account of the Cascade Forest Reserve, p. 36, says that the larch "has done more than any other species to restock the immense burns that have occurred on a part of the reserve. This is largely due to the fact that the thick bark of this tree resists fire better than any other species, and more trees are left to cast their seed on the clean loose soil and ashes immediately after a fire. The seeds are small and light, and are carried to remote places by the wind and covered deeply by the fall rains. In the spring a dense mass of seedlings covers the ground and grows rapidly. The thickets become so dense that it is impossible to travel through them. In time only the fittest survive, and there remains a thrifty, vigorous stand of this valuable timber." In Montana the lodge-pole pine usually takes possession of burnt areas; but I saw near Belton on the Great Northern Railway a hillside which had been swept by a fire, leaving a good number of larch trees unharmed, all the trees of other species being destroyed, and larch seedlings were coming up in profusion. On the Stillwater Creek farther west I noticed a burnt area on which the lodge-pole pines were about 30 feet high; and amongst them larch seedlings were growing in openings exposed to sunlight during at least a part of the day. Here in time the lodge-pole pine will be supplanted by the larch. Sargent's statement,[1] that young seedlings of the western larch are able to grow up under the shade of other trees, which they finally overtop and subdue, requires modification. Seedlings never occur in the shade of the forest, and are most numerous in open places exposed to full sunlight; but on good soil, as on a recently burnt area, they will spring up in the partial shade of small pine trees. The western larch is not a fast grower in the young stage; at Belton seedlings twelve years old, growing on rather poor rocky ground, were from 7 to 12 feet high.

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[1] *U.S. Geol. Survey, Flathead Forest Reserve*, 256, 314 (1900).

As the seed of the western larch had never been collected, so far as we knew, by any one except Mr. Carl Purdy's collector in 1903, I visited Montana in 1906, with the object of collecting a large quantity for Sir John Stirling Maxwell and Lord Kesteven. In the common larch the seeds do not fall out of the cones until spring, and their collection during winter is an easy matter. The western larch behaves very differently, as will be seen by the following notes of my observations in Montana. About the middle of August the squirrels begin to throw down cones, a sign that the seeds are nearly ripe. About the 10th September the leaves, which form a tuft at the base of the cone, begin to turn yellow, and in a day or two become brown and withered, showing that the supply of nutrition to the cone is stopped. The cones, which until now were purplish in colour, become brown, and the scales gape open widely, allowing the seeds to escape. By the 20th September all the cones on the trees have become quite brown, and have emptied all their seeds. The empty cones remain on the branches till the autumn of the following year, by which time their peduncles have rotted and the cones are ready to fall. For collecting seed the larch forests must be visited during the first three weeks of September; and localities where felling is being carried on should be chosen, as the cones occur only at the summit of very tall trees, which are troublesome to cut down, even if permission to do so has been obtained from their owners. The western larch appears to produce a good crop of seed once every two or three years, and this is general over the whole region. 1906 was a remarkably poor year, scarcely any cones having been formed. In 1905, judging from the old cones of that year still remaining on the trees, the crop of seed was very abundant. (A. H.)

As I had long been trying to find a larch that would in England be less liable to the attacks of *Peziza Willkommii* than the common larch, I made inquiries as to how seeds could be procured, and Prof. Sargent was good enough to do his best for me. Mr. Leiberg, in 1901, went on purpose to the Flathead Lake country, but found all the seed shed as early as September, and could only send a few seedlings by post. These heated on the way to England, and though I saved a few of them, they were always sickly, and most of them died before coming into leaf. Again I tried through the United States Forestry Bureau, who were also unable to get seed. In 1903, however, I procured a small parcel from Mr. Carl Purdy, and distributed the seed to many arboriculturists in England in 1904. These have germinated fairly well, and I hope that my efforts to make this grand tree better known may succeed.

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[1] *Garden and Forest*, ix. 491 (1896), where there is an article on the tree, with an illustration of the trunk, fig. 71, showing the very thick bark.

The seedlings raised in 1904, from the seed which I distributed, have grown in several places, best perhaps at Murthly, under the care of Mr. Lowrie, where in September 1906 I saw some hundreds thriving very well, though not so large as common larch of the same age. At Walcot, in rather dry soil, they were 6 to 9 inches high. At Colesborne they grew slowly, and many were killed or injured in the seedbed by the frost of May 1905; but I have just planted out a number which were raised for me by Messrs. Herd of Penrith, and which are 12 to 18 inches high.

I visited Missoula in June 1904 on purpose to see the tree, and was fortunate enough to do so in company with Prof. Elrod of the Montana University, to whom I am greatly indebted for the excellent photographs of the tree here reproduced (Plate 111). They were taken on the Big Blackfoot river about twenty miles up the valley from Bonner, on the Northern Pacific Railway, where a large sawmill, managed by Mr. Kenneth Ross of the Big Blackfoot Lumber Company, has its headquarters. Guided by this gentleman we reached the logging camp in the Camas prairie and found the larch growing in deep bottom land at about 3500 feet, mixed with *Pinus ponderosa* and Douglas fir, but far exceeding both of them in size. The tree grows on slopes and in ravines where there is a good depth of soil not liable to dry up, and best on slopes with a north and east aspect, and on the rich detritus at their foot, and along the sides of the river. It differs strikingly from other larches in habit when adult, having very short branches, which are not produced singly or at regular intervals but grow in irregular groups of four or five, starting near together on the trunk. It forms a tall, very narrow column, and as it gets old loses many of its branches. It carries its girth to a great height and is, when grown in a thick forest, sometimes clear of branches for over 100 feet. The tallest tree I have heard of was figured in the *Butte Miner* of 29th February 1904, and was said to be the largest in Montana, 233 feet high and 24 feet in girth at or near the ground. This tree grew on the Upper Clearwater between Salmon and Seely lakes. It could be seen for miles above the surrounding trees, and must have contained over 2000 feet of timber. The best I saw, however, were from 150 to 180 feet in height, with a girth at 5 feet of 10 to 15 feet.

Frank Vogel, a timber surveyor who has had much experience with this tree, told me that it grew up to 6000 feet elevation on the hills above the Blackfoot river, and that he saw no difference between these trees and those lower down except in size. The age of those of which I counted the rings, and which would be about the same age as the one photographed, was 330 to 350 years, these trees showing no signs of decay. The bark in dense forest is very thin for such large trees, sometimes only 2 to 3 inches thick, and though in older and more isolated trees it attains a much greater thickness, as much as 9 to 15 inches near the ground, it struck me as not being so thick and rugged as the bark of old European larch.

The undergrowth in the forest was not dense, and was composed of *Berberis aquifolium*, *Cornus canadensis*, *Linnæa borealis*, *Symphoricarpus*, *Thalictrum*, with violets, strawberries, and in some places that lovely little orchid *Calypso boreale*. There were abundant seedlings of larch and Douglas fir springing up wherever there was enough light and moisture, but in the drier parts of the forest pine only was seen. The young cones were already formed on 29th May, and I came away with the impression that though this tree may not rival the European or Japanese larches in rapidity of growth, it will be valuable in the mountains of Central Europe and will probably succeed on the better soils of England and Scotland.

With regard to the timber of the western larch, Prof. Sargent says that "it surpasses that of all other American conifers in hardness and strength, it is very durable, beautifully coloured, and free from knots; it is adapted to all sorts of construction, and beautiful furniture can be made from it. No other American wood, however, is so little known." Through the kindness of Mr. K. Ross I was able to bring back from the St. Louis Exhibition a door and frame made from this wood which fully bears out Sargent's high opinion of it.

Until a few years ago the timber of the western larch was invariably called tamarack, and was of no great commercial importance. The use of this name, which is properly applied to *Larix americana*, the timber of which is little esteemed, proved prejudicial to the reputation of the western larch in the eastern states. Of late years the timber merchants of Idaho and Montana insist on the use of the term larch; and large quantities of this lumber are now being exported even as far east as New York. Coarse grades are used for joints, beams, and railway ties. Finer grades are sawn into planks, used for flooring, and are converted into materials for indoor finish, as ceiling, laths, mouldings, panelling, etc. The timber is remarkably free from knots, and is variable in colour, being often nearly white, though it is usually reddish in tint. (H. J. E.)

LARIX LYALLII, Lyall's Larch

Larix Lyallii, Parlatore, *Enum. Sem. Hort. Reg. Mus. Flor.* 1863, *Journ. Bot.* i. 35 (1863), and *Gard. Chron.* 1863, p. 916; Sargent, *Gard. Chron.* xxv. 653, f. 146 (1886), *Silva N. Amer.* xii. 15, t. 595 (1898), and *Trees N. Amer.* 37 (1905); Kent, *Veitch's Man. Coniferæ*, 399 (1900).

A tree attaining in America 80 feet in height and 12 feet in girth, but usually considerably smaller. Bark of young stems and branches thin and pale grey, on larger stems loose and scaly, on older trunks 2 inches thick and fissuring into irregular plates covered by reddish-brown loose scales. Young branchlets covered with a dense greyish tomentum, concealing the pulvini, and partly persistent on older branchlets, which become greyish black in colour. Short shoots stout and greyish pubescent. Bud-scales fringed with long cilia. Base of the long shoots girt with a sheath of the previous season's bud-scales, the uppermost of which are loose, membranous, and reflected.

Leaves bluish green, rhombic in section, deeply keeled on both surfaces, 1 to 1½ inch long, rigid, ending in a sharp cartilaginous point.

Staminate flowers ovoid, acute at the apex, ⅓ inch long, raised on stalks ⅕ inch long. Pistillate flowers ovoid, with the bracts reflected about their middle, their mucros curving outwards; bract oblong, ⅕ inch long, truncate at the apex, the midrib being prolonged into a rigid mucro about ¼ inch long.

Cones ovoid, acute at the apex, 1½ to 2 inches long, on a short tomentose stalk: scales numerous, loosely imbricated, thin, ovate, of a beautiful pink colour before ripening, ½ inch long, fringed with matted hairs; outer surface sparingly pubescent: bracts extending up to the margin of the scale, with their mucros projecting beyond about ¼ inch and at first directed upwards; when ripe the scales spread at right angles and finally, together with the bracts, become much reflexed. Seeds in slight depressions on the scale, with their wings narrowly divergent and not reaching its upper margin. Seed together with wing about 7/16 inch long; wing pale pink in colour, broadest near the base.

This species has been supposed to be an alpine form of *L. occidentalis*; but is readily distinguished from it by the structure of the leaves, the tomentum of the branchlets, the beautiful pink cones, which have fringed scales, and the pink-winged seeds. (A. H.)

This tree was discovered by Dr. D. Lyall when surgeon to the International Boundary Commission in British Columbia in 1858, and though I have raised seedlings which I believe to be this species, it has not as yet been introduced into cultivation either in America or Europe, though it is a tree which must have been seen by thousands of travellers while crossing the Rocky Mountains in the Canadian Pacific Railway. Plate 112 shows a typical tree growing near Laggan, and is from a negative which I purchased at Victoria.

It is a strictly alpine tree, of somewhat limited range, its northern limit being about 51° N. on the Rocky Mountains, not extending to the moister climate of the Gold or Cascade ranges in British territory, nor has it as yet been discovered in the more northern parts of British Columbia. Southwards, it extends along the Cascade Mountains of Northern Washington to Mount Stewart on the north fork of the Yakima river, and along the continental divide of the Rocky Mountains to the middle fork of Sun river and to Pend d'Oreille pass in North-Western Montana.[1] In its northern habitat—near Laggan, Alberta—I have seen it from about 5000 up to 7000 feet. Though Mr. J. Macoun reports it on a mountain near Morley as low as 4500 feet, yet Wilcox,[2] who must have seen as much of this tree as any one who has written of it, says it is rarely seen below 6000 feet, and that its extreme range of altitude might be placed between 5600 and 7600 feet.

Lyall's larch is a very beautiful tree of moderate size, from 50 to 70 feet high being about the average, with a girth of 5 to 6 feet, but on Mount Stewart Mr. Brandagee reported that it attained as much as 4 feet in diameter. Its growth is extremely slow, Wilcox having counted 30 rings of growth in a branch only ¾ inch in diameter; whilst a tree cut by Brandagee on Mount Stewart which showed 562 annual rings was only 16½ inches in diameter under the bark.

Mr. M. W. Gorman says:[3]—Near Lake Chelan it was not seen at all in the moist valleys, and was generally found to favour the passes and sheltered sides of the crest lines and divides, and here it ranges in altitude from 5800 to 7100 feet. The best grove seen was at about 6700 feet elevation near War Creek pass. The tree ranges in height from 50 to 90 feet, and in diameter from 10 to 25 inches. The mature tree has a rather thick greyish bark, and is well fruited with oval, mostly erect persistent cones. The branches are mostly lateral, very brittle, and quite small in proportion to the tree. The foliage changes colour with the first severe frosts about October 1.

L. Lyallii has to contend with a climate as severe as, and very similar to that of the Altai Mountains, the snow usually lying till late in June or even July, and snow and frost often occurring in July and August. The bark is rough and greyish and the branches short, irregular, brittle, and easily broken by a heavy snowfall. Wilcox says that the trees growing at the highest altitude have a curious development not found on those only a few hundred feet lower. The tufts of leaves spring from a hollow woody sheath, which is sometimes more than an inch long on the trees at high altitudes, whilst elsewhere this is not present.

The seed appears to ripen and shed early like that of the western larch, for though I have made several attempts to procure it from friends visiting the Rockies they have been, like myself, always too early or too late, and though I tried to bring home seedlings in 1893 they died on the journey home.

It is not, however, at all likely to succeed in this country, except possibly on the higher parts of the Grampian Mountains, and even there I fear the climate will be too damp, and the winter too short for it. (H. J. E.)

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[1] Sheldon, in *Forest Wealth of Oregon*, says that it is "rare on the high peaks of the Wallowa Mountains."

[2] *The Rockies of Canada*, 63 (1900).

[3] *U.S. Geol. Survey, Eastern Part oj Washington Forest Reserve* (1899). Mr. Gorman calls the tree *L. occidentalis*; but his specimens, which we have seen, are labelled *L. Lyallii* by himself, and are this species.

LYALL'S LARCH IN MONTANA

Larix Lyallii occurs in five isolated areas in the mountains of Northern Montana, between 113° and 115° E. long. and 47° 25′ and 49° N. lat.

One of these localities was discovered by Prof. Elrod and myself in our ascent of the unexplored peak of St. Nicholas, which lies just west of the continental divide, about ten miles east of Nyack on the Great Northern Railway. Here about 1000 trees grow on a rocky precipitous slope, with a strictly northern aspect, and extend in scattered groves over about a mile of ground between 6600 and 7500 feet altitude. The tree is, owing to lack of moisture in the soil, unable to exist on the sunny southern slopes, where *Pinus albicaulis* thrives at similar altitudes. Separate groves of Engelmann's spruce accompany the Alpine larch. The largest tree measured 71 feet by 5 feet 2 inches; and another tree, felled by us, which was 8 inches in diameter, showed 220 annual rings, the sapwood with 25 rings being half an inch thick. Younger trees up to 40 feet high are gracefully pyramidal in shape, with wider branches than *L. occidentalis*; older trees have twisted and irregular branches and flattened crowns, the result of age, as is the case in all species of larch. The branches are remarkably brittle. On another part of the mountain, but still on the northern aspect, eighteen trees in two groups were seen at 8250 feet elevation, the tallest of which was only 10 feet high. The trees in Montana bore in 1906 only a few cones, but the crop in the preceding year had been plentiful. I procured only twenty or thirty seeds, which are now being raised at Kew. The cones in this species resemble those of the western larch in the manner in which they quickly cast their seeds in September.

The western larch in this region did not mingle with the Alpine larch, the former ascending, in company with Douglas fir, the northern slope up to 5900 feet; and between this elevation and 6600 feet, where the lowermost Alpine larch was found, no trees were growing.

Two other localities farther south are mentioned by Ayres,[1] who states that on the summit of the continental divide (long. 113°, lat. 47° 25′), between the Sun river and Willow Creek, there is a fine forest of the species, with trees about 70 feet high and 15 inches in diameter. Twenty miles due west on the summit of the range north of Pend d'Oreille pass there are a few scattered trees.

In the Whitefish range and in the mountains between the Kintla and Chief Mountain lakes, the tree is common on northern slopes from the Canadian boundary line to about 15 miles south of it. In the Whitefish range, Ayres[2] reports that the trees attain a maximum size of 80 feet by 6 feet in girth, the largest growing about the heads of basins where the snow lingers late into summer or lies in banks throughout the season. I visited the Whitefish range, which is a few miles from Fortine, on the Great Northern Railway, late in September, in company with Mr. Eastland, forest ranger, and at 7000 feet altitude could distinguish numerous groves of Alpine larch, extending over the mountains for an immense distance, as the foliage,

[1] *U.S. Geol. Survey, Lewis and Clarke Forest Reserve*, 42, 43 (1900).

[2] *U.S. Geol. Survey, Flathead Forest Reserve*, 268 (1900).

which had turned yellow at this season, rendered the trees very conspicuous ; but in all cases the groves were confined to strictly northern slopes. We encamped in a small grove, where the trees did not exceed 40 feet in height, and observed numerous seedlings ; but were forced to descend on account of a heavy fall of snow and to leave the larger and more important forests unvisited.

Further east, in the Kintla lake region, Ayres[1] reports that the mountain slopes are best wooded on the northern slopes, where the Alpine larch reaches a height of 80 feet and a diameter of 30 inches. It is more vigorous here than in any other locality seen by Ayres, who considers that the tree will produce timber suitable for mining purposes. (A. H.)

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[1] *U.S. Geol. Survey, Flathead Forest Reserve*, 277 (1900).

PINUS LARICIO[1]

Pinus Laricio,[2] Poiret, *Lamarck's Dict.* v. 339 (1804); Lambert, *Genus Pinus*, i. 11, t. 4 (1832); Loudon, *Arb. et Frut. Brit.* iv. 2200 (1838); Forbes, *Pinetum Woburnense*, 23 (1839); Parlatore, DC. *Prod.* xvi. 2, p. 386 (1868); Masters, *Gard. Chron.* xx. 785, fig. 142 (1883); xxi. 18, fig. 1 (1884); iv. 692 (1888), *Journ. Linn. Soc.* (*Bot.*) xxxv. 624 (1904); Willkomm, *Forstliche Flora*, 226 (1887); Mathieu, *Flore Forestière*, 596 (1897); Kent, *Veitch's Man. Coniferæ*, 338 (1900).
Pinus nigra, Arnold, *Reise nach Mariazell*, 8 (1785); Kirchner, *Lebengesch. Blutenpfl. Mitteleuropas*, 231 (1906).
Pinus austriaca, Höss, *Flora*, viii. *Beiträge*, 113 (1825); *Gard. Chron.* ix. 275, figs. 49, 50 (1878).
Pinus nigricans, Host, in Sauter, *Versuch Geog. Bolan. Schilderung Umgeb. Wiens*, 23 (1826).
Pinus taurica, Loddiges, *Cat.* (1836).
Pinus caramanica, Bosc. *ex* Loudon, *op. cit.* 2201 (1838).
Pinus dalmatica, Visiani, *Fl. Dalmat.* i. 199 (1842).
Pinus monspeliensis, Salzmann, *ex* Dunal, *Mém. Acad. Montpell.* ii. 82 (1851).
Pinus Salzmanni, Dunal, *loc. cit.*
Pinus calabrica, *cebennensis*, and *poiretiana*, Hort, *ex* Gordon, *Pinetum*, 168 (1858).
Pinus Fenzleyi, Carrière, *Rev. Hort.*, 1864, p. 259.
Pinus Fenzlii, Antoine et Kotschy, *ex* Carrière, *Conif.* 496 (1867).
Pinus pindica, Formanek, *Verhandl. Naturf. Verein Brünn*, xxxiv. 20 (1896); Masters, *Gard. Chron.* xxxi. 302, figs. 95, 96 (1902).

A species very variable in habit, dimensions, and foliage, comprising several different geographical forms, which under cultivation preserve in a great measure their peculiarities. The following description is drawn up from wild specimens of the Corsican tree, which is the finest form.

A tree attaining 150 feet in height and 20 feet in girth. Bark on old trees about an inch thick, deeply fissuring into irregular longitudinal plates, which exfoliate in small rounded scales, leaving exposed pale brown, slight oval depressions where they fall off. Buds $\frac{1}{2}$ to 1 inch long, elongated, abruptly contracted to an acuminate apex, light brown in colour, tinged with white, the lowermost scales loose and reflected, the uppermost bound together by white resin. Branchlets stout, glabrous, brown in colour; leaf-bases very prominent, keeled, and imbricated, persisting for several years on the older leafless branchlets.

Leaves, in pairs, densely covering the whole branchlet on barren shoots, forming an apical cup-like tuft above, directed upwards and forwards below; deciduous in the fourth or fifth year; stout, 4 to 6 inches long, about $\frac{1}{16}$ inch wide, straight or curved, often twisted,[3] serrulate, ending in a short callous point; semi-terete in section, with twelve lines of stomata on the convex surface and eight lines on the flat surface; resin canals median, surrounded by stereome cells, meristele elliptic, fibro-vascular bundle branched. Basal sheath about ½ inch long, brown near the base, whitish above, becoming on old leaves short, lacerated, and blackish.

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[1] The generic description of Pinus will be given in a later part. There is no English name in common use for the whole species. The different forms are well known, as the Corsican, Austrian, and Pyrenean Pines.

[2] The oldest name for the species is *Pinus nigra*, Arnold, which has lately been revived by some German writers. We adopt the name *Pinus Laricio*, Poiret, as it has been in general use for more than a century.

Pinus pallasiana, Lambert, *Genus Pinus*, i. 13, t. 5 (1832), is impossible to recognise, being supposed by some to be *Pinus Laricio* and by others to be *Pinus Pinaster*.

Pinus pyrenaiaca, Lapeyrouse, *Hist. Pl. Pyrén.*, *Suppl.* 146 (1818), points, so far as the locality is concerned, to the Pyrenean variety of Laricio; but the description is doubtful. Mr. H. L. de Vilmorin, who gives a history of this name in *Bull. Soc. Bot. France*, xl. p. lxxvii (1893), considers it to refer to *Pinus Brutia*; but M. Calas, in his account of the *Pin Laricio de Salzmann*, p. 22, controverts this opinion, and believes the description to apply to the Pyrenean Laricio.

[3] The twisting of the leaves, supposed to be characteristic of the Corsican variety, is an inconstant character.

Male flowers clustered, three to ten or more in number, on the lower half of the branchlet of the first year, which grows beyond the inflorescence and bears leaves above; later, when the flowers drop off, these fertile branches appear to be bare of leaves in their lower half. The male flowers are upright, yellow, cylindric, stalked, about an inch long; connective crest large, purplish, finely toothed. Female flowers single or two to three at the top of the young branchlets, very shortly stalked and bright red in colour, remaining as small (½ inch diameter) globular cones till the beginning of the second year.

Cones ripe at the end of the second year, solitary or in pairs or threes, subterminal, sessile; variously directed, upwards, horizontally, or even curving downwards; shining brown; ovoid-conic, 2 to 3 inches long by an inch in diameter, straight or curved, symmetrical, ending in a narrow apex. The cones open in the spring or summer of the third year and soon after the escape of the seeds fall off. Scales about an inch long; concealed part thin, dark reddish brown below and light brown above; apophysis or visible part shining yellowish brown, raised, rounded at the upper margin, with a transverse keel, curved on each side of the central umbo, which is reddish brown and bears a minute or obsolete prickle. Seeds greyish or brownish, more or less mottled, about ⅙ inch long; wing three or four times as long, striated light brown, straight on one side and gently curved on the other, about ¼ inch wide at the broadest part, which is at the middle or just below it. Seedling with six or seven cotyledons.

The different geographical forms may be arranged as follows:—

1. Var. *corsicana*, Loudon, *loc. cit.* (var. *poiretiana*, Antoine, *Conif.* 6: 1840), Corsican Pine. Occurs in south-east Spain, Corsica, southern Italy, Greece, and Crete.

A tall tree with straight stem and slender branches. Leaves light green in colour, not extremely dense upon the branchlets, the whole aspect of the foliage being lighter in colour and sparser in quantity than in the Austrian pine. Buds not very resinous. Cones usually without radiating cracks on the apophyses.

Var. *calabrica*, Loudon, *loc. cit.*, is scarcely distinguishable. As seen under cultivation at Les Barres, it has perhaps slightly denser foliage than the Corsican variety growing beside it.

2. Var. *austriaca*, Loudon, *loc. cit.* (*Pinus nigra*, Arnold; *Pinus austriaca*, Höss; *Pinus nigricans*, Host; *Pinus Laricio*, var. *nigricans*, Parlatore). Austrian Pine. Austria, Balkan Peninsula, Crimea, Caucasus, Asia Minor.

Shorter tree, with numerous stout branches. Leaves dark green in colour, extremely dense upon the branchlets, giving the whole tree a dense dark crown of foliage. Buds resinous, whitish, stouter than in the Corsican pine. Cones usually showing radiating cracks in the apophyses.

Var. *pallasiana*, Endlicher, *Syn. Conif.* (*Pinus pallasiana*, Loudon, *op. cit.* 2206).

This name is given in England to trees with numerous stout branches, the lowermost of which ascend parallel to the trunk; but in foliage scarcely different from the Austrian pine.[1] The cones are usually larger than in that variety and have the radiating cracks strongly marked. This form is supposed to have come from the Crimea. The Laricio which occurs in the Crimea, Asia Minor, and the Caucasus appears, however, to be identical with the Austrian form.

Var. *caramanica*, Loudon, *loc. cit.* (var. *Karamana*, Masters, *Gard. Chron.* 1884, xxi. 480, fig. 91). This is the Austrian pine as regards the foliage; but producing extraordinarily large cones, up to four inches or more in length. It is supposed to be identical with a form introduced into Paris by Olivier, who sent seeds in 1798 from Caramania in Asia Minor; but is perhaps only a mere sport of the common Austrian pine. The only specimens known to us are two trees at Syon, grown on the lawn west of the mansion; and one of these measured, in 1903, 72 feet by 8 feet 6 inches.

3. Var. *tenuifolia*, Parlatore, *loc. cit.* (vars. *pyrenaiaca et cebennensis*, Grenier et Godron, *Flore de France*, iii. 153 (1856). *Pinus monspeliensis*, Salzmann. *Pinus Salzmanni*, Dunal). Pyrenean Pine. Cevennes and Pyrenees.

Small trees, often stunted in growth, with remarkably slender leaves, only half the thickness of the other forms. Young branchlets orange-coloured. Cones smaller than in the Corsican variety. Owing to its slow growth, the annual shoots are very short, and the older branchlets remain slender and bare of leaves for a great distance behind the short tuft of leaves at their extremities.

Pinus leucodermis, Antoine, treated by us as a distinct species, is considered by many authorities to be only an alpine form of Laricio; and there appear to be similar forms occurring in high regions elsewhere, as *Pinus Fenzlii*, Carrière, which resembles *P. leucodermis* in having short leaves, almost appressed together in the bundles.

Pinus pindica, Formanek, reported as growing in the Pindus and the Thessalian Olympus, is not recognised by Halacsy;[2] and is probably only a slightly aberrant form of the ordinary Corsican variety. It has been fully described and figured in *Gardeners' Chronicle*, *loc. cit.*, by Dr. Masters.

Horticultural varieties of Laricio are few and unimportant. Beissner[3] mentions pendulous, variegated, and dwarf forms. A golden variety[4] of the Austrian pine, said to have been raised or introduced by Mr. Mongredien of the Heatherside Nursery, has the leaves, especially those on young growths, tipped with gold. Ilsemann[5] saw a tree, in which the leaves were beautifully variegated with yellow, growing wild in a forest in Hungary. A peculiar form of Austrian pine with stout falcate leaves has been observed at Breslau.[6]

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[1] Probably some trees called *Pallasiana*, on account of their habit, are really of Corsican origin.

[2] *Consp. Fl. Græcæ*, iii. 452 (1904).

[3] *Nadelholzkunde*, 243 (1891). Masters saw at Moser's Nursery, Versailles, in 1903, a dwarf variety of very compact habit with dense bright green foliage: *Gard. Chron.* xxxiv. 338 (1903).

[4] *Gard. Chron.* xvi. 507 (1881) and ii. 730, 785 (1883).

[5] *Gartenflora*, 1897, p. 643.

[6] Baenitz, *Gartenflora*, 1903, p. 58.

INTRODUCTION

According to Loudon,[1] the Corsican variety was introduced into England, as long ago as 1759, under the name *Pinus sylvestris, ε maritima*, which was adopted by Aiton.[2] In France, the tree in the Jardin des Plantes at Paris was planted in 1774; but the date of introduction of the first seed is probably earlier. The Austrian pine was introduced[1] in 1835 by Lawson of Edinburgh. Var. *pallasiana* was first raised by Messrs. Lee and Kennedy, Hammersmith, from seeds sent to them about the year 1790 from the Crimea by Professor Pallas.[1] Captain Cook[1] imported seed in 1834 from the Sierra de Segura in the south of Spain; but the plants raised were probably indistinguishable from the ordinary Corsican variety; and there is no record of the introduction of the Pyrenean or Cevennes variety, of which we know of no large trees in this country.

DISTRIBUTION

The species has a widespread distribution, extending westwards from Spain into the Cevennes in France, finding its northerly limit in Austria, and descending into Corsica, Italy, Sicily, the Balkan peninsula, Greece, Crete, and Cyprus, it reappears in the Crimea and in Asia Minor, and reaches its most easterly point in the Caucasus.

In Spain, a form considered by Willkomm to be identical with the Corsican variety occurs scattered through the plateaux and mountains of the south-eastern and central provinces, at altitudes between 1000 and 3500 feet. The largest forests occur in the Serrania de Cuenca, and in the sierras of Segura and Cazorla, the most southerly point reached being in the last-named mountain in N. lat. 37° 40′ and W. long. 3°.

PYRENEAN LARICIO.—The form[3] which occurs in the Pyrenees and the Cevennes is remarkable for its stunted growth and slender leaves. It grows on the Spanish side of the Pyrenees in the province of Aragon, not far from Venasque, between the rivers Esera and Cinca. From this locality, which was visited by Mr. H. L. de Vilmorin in his investigations of the Pyrenean Laricio,[4] seeds were regularly sent to Paris for many years early in the 19th century, by M. Boileau, pharmacist at Bagnères-de-Luchon.

M. Calas, who has written an elaborate memoir[5] on this variety, accompanied by a map of its distribution and numerous illustrations of the forests reproduced from photographs, discovered it in 1890 on the north side of the Pyrenees near Prades. Here it covers a scattered area of about 3600 acres in the hills south of the river Têt and north of Mount Canigou, the district being called Conflent; and grows on glacial clay at elevations between 1880 and 3300 feet. In most places the original forest has been ruined by sheep-grazing and fires, and usually only small isolated groups of trees are to be seen, in the ravines and on the precipices. There are, however, two woods of considerable extent; and one of these, situated in the basin of the stream of Masos, is considered by M. Calas to be the finest which he has seen, as regards the density, regularity, size, and vigour of the trees, which are, however, only about 80 to 90 years old. The best trees in the district are 50 to 60 feet high by 3 to 4 feet in girth.

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[1] *Op. cit.* 2204, 2206, 2208, 2209. The date for the Corsican pine is not improbable, as Loudon (viii. t. 315) gives a figure of a tree at Kew, which was 85 feet high in 1838.

[2] *Hort. Kew.* iii. 366 (1789).

[3] Cf. Durand, in *Bull. Soc. Bot. France*, xl. p. ccxxviii (1893).

[4] *Ibid.* p. lxxvii.

[5] *Le Pin Laricio de Salzmann*, pp. 50, tt. 1-19. Published at Paris by the Minister of Agriculture in 1900.

In the Cevennes, this variety occurs in three localities. In Herault, near Saint-Guilhem-le-Désert,[1] it covers, between 1700 and 2300 feet elevation, about 2400 acres, of which 1900 have lately been purchased by the Government. The soil is dolomite limestone and is extremely poor and shallow; and the trees growing either on southern arid slopes or on wind-swept plateaux are in a worse condition than elsewhere. They usually have twisted stems and average 15 feet in height; attaining at their best 30 feet high by 3 feet in girth.

Another locality[2] occurs north of Bessèges, in the valley of the river Gagnières, which forms the boundary line between the departments of Gard and Ardèche. The tree grows here at 650 to 1100 feet elevation on siliceous soil, and covers a scattered area of 2500 acres, half of which belongs to the State. It often attains, on northern slopes and on slightly better soil than usual, 60 feet high by 4 feet in girth. This appears to be the only locality where the tree is regularly felled, the timber being sold for pit-props. The maritime pine has been planted in the district in the open spaces caused by forest fires, and though slightly faster in growth than the native Laricio, has proved to be a poorer tree, on account of the inferior quality of its timber.

M. Fabre discovered in 1897 a third locality in the Cevennes, at the Col d'Uglas, eight miles west of Alais in Gard. The area is only 250 acres; but is interesting, on account of *Pinus sylvestris* growing wild in company with *Laricio* in the upper part of the forest.

The Pyrenean pine has been planted in a few localities in Ardèche, Herault, Aude, and Pyrénees Orientales; and has done slightly better than the Austrian pine tried with it. Calas considers it to be a useful tree, on account of its capability of growing on the worst possible soils; and is of opinion that its meagre growth in the wild state is entirely dependent on the poor conditions of soil and climate to which it is subjected.

CORSICAN PINE.—This species is widely spread in Corsica in the great mountain range and its ramifications, which occupy the centre of the island. On northern slopes it grows between 2700 and 5500 feet elevation, the lower margin of the forest being often contiguous with dense woods of *Quercus Ilex* or with scattered groves of *Quercus lanuginosa*. On southern sunny slopes it only descends to 3700 feet, the zone below that altitude being usually occupied by *Pinus Pinaster*, the two species mingling slightly at the line of junction. The forests of *Laricio*, often of great extent, belong almost entirely to the State and to the Communes, and are all treated by the selection method. The pine usually occurs pure; but in the ravines small and unimportant groups of silver fir are often seen, and the edges of the streams are bordered in many places by *Alnus cordifolia*. The beech in Corsica attains as high an elevation as *Laricio*, and in some cases the two species are mixed, and a struggle occurs for predominance. Birch is occasionally a component of the pine forest, but is comparatively rare. The soil on which *Laricio* grows is usually extremely poor, consisting of debris of granite rocks, and contains very little humus or decayed vegetable matter.

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[1] Here this variety was first discovered in France by Salzmann in 1851.

[2] First mentioned in 1856 by Grenier and Godron, *loc. cit.*

The following observations which were taken in 1906, at 3200 feet altitude, in the midst of the *Laricio* forest at Vizzavona, show the climate in which the tree thrives:—

	Precipitation in inches.	Days of Fall of		Temp. Fahr.	
		Rain.	Snow.	Max.	Min.
January	10.98	4	5	47°	18°
February	3.74	3	13	46°	16°
March	4.05	5	6	64°	21°
April	3.46	12	4	59°	27°
May	5.28	13	1	75°	32°
June	0.31	7	...	75°	43°
July	1.61	8	...	77°	46°
August	0.12	2	...	79°	48°
September	1.73	3	...	77°	39°
October	7.60	5	...	66°	41°
November	14.61	14	1	61°	30°
December	15.44	8	11	59°	16°
Total	68.93 inches.	84 days rain.	41 days snow.		

Snow and low but not extreme temperatures are common during nearly six months of the year, from November to the beginning of May. The sky is generally clouded more or less completely during a greater part of the year; a clear blue sky only being recorded on 77 days out of the whole year.

The *Laricio* forests are easy of access, owing to the railway, which goes through the heart of the mountains from Ajaccio to Bastia; and in spite of a heavy fall of snow I succeeded in seeing some of the most important forests in the last week of December 1906. The finest is Valdoniello, which lies about twenty miles west of Corte railway station, the road to it passing through the magnificent gorge of the Scala di Santa-Regina. This forest occupies the upper basin of the river Golo, which has a north-easterly exposure, and its wooded area covers 6682 acres lying between 3100 and 5100 feet altitude. The soil is very dry and extremely poor, consisting of granite debris; and the few beech and silver fir that were seen could only obtain a footing in the ravines. The forest is divided into two series, one of which, about 4000 acres in extent is being regularly felled, whilst the other series at a greater elevation is left untouched as a zone of protection. In the first series there are 109,000 trees over 16 inches in diameter, 4000 of which are decayed or diseased. Only trees over 9 feet in girth are marked for felling; and these are being cut down gradually, two or three trees in each spot, so that gaps are left in which seedlings may spring up. Though good seed years occur about once every three years, natural regeneration is always difficult on account of the poverty and dryness of the soil, and only occurs in open spaces exposed to sunlight. As a great deal of the best timber has been removed in past years, the number of excessively large trees is limited, there being only thirteen over 14 feet in girth. The largest tree now standing, the "Roi des Laricios," is growing in a dense part of the forest at 3850 feet altitude, and measured 143 feet in height by 18 feet 9 inches in girth, with a clean stem to 100 feet. Plate 113, from photographs taken by me, shows the stem of this tree and a dense stand of pines. Plate 114, from a negative kindly lent us by M. A. André, Inspector of the French Forest Service, shows very well the peculiar habit assumed by the Laricio in old age, the crown becoming remarkably flattened, owing to the bending over of the leading shoot and the increase in size of the upper branches, which become very stout and horizontal or even curve slightly downwards. The frontispiece is reproduced from a sketch taken in Corsica by the late Robert Elwes of Congham, Norfolk.

In this forest the presence of a considerable number of diseased trees is probably explained by the fact that some twenty years previously most of the large trees had been tapped for resin, an operation which was not justified by its financial results, and which exposed the trees to the attacks of fungi. In many parts of the Valdoniello forest, as in *parcelle F*, the trees are very tall, and stand very close together, and have beautifully clean stems, showing that the tree bears crowding without injury. The foliage of the trees in Corsica struck me as being denser than is the case usually in isolated trees growing in England; and I agree with Prof. Fliche that the canopy of Laricio is considerably denser than that of the Scots pine, and as a corollary that plantations should not be over-thinned. In Corsica, as only trees of large size are saleable, no thinning operations are ever attempted.

The railway passes through another fine forest, that of Vizzavona, which is about 3400 acres in extent. The trees here are as a rule younger than those at Valdoniello, and in many parts of the forest are mixed with beech, between 3000 and 4000 feet. In one place it was evident that, owing to an excessive felling of *Laricio* several years ago, the young forest coming up will consist almost entirely of beech. In pure stands of young but tall pines there is usually a slight undergrowth of beech and holly. Near the forester's house I measured a large tree, 145 feet high by 12 feet 3 inches in girth, which was growing at 3200 feet altitude.

With regard to the size attained by *Laricio* in Corsica, a tree in the forest of Pietropiano with a short stem measured 23 feet in girth. In the forest of Marmano trees have been felled which were clean in the stem to 115 feet, and yielded 950 cubic feet of dressed and squared logs. At Aitone there is a fine forest of Laricio which I was unable to visit from Valdoniello, as the pass across the mountain was impassable owing to deep snow. I was informed that the forest of Asco has been practically untouched by the axe, and contains many very old trees of peculiar habit.

The *Laricio* grows with extreme slowness in the mountains of Corsica, trees 40 inches in diameter averaging about 360 years old, and those over 5 feet in diameter are often as much as 700 years.

The timber of young trees is valueless in Corsica, as it contains practically only sapwood, which rapidly decays on exposure to the air. The sapwood is white in colour, and always considerable in thickness, varying on an average from 8 inches in young trees (77 years old) to 2 to 3 inches in old trees (250 years old and upwards). The heartwood, which is reddish brown, only develops in quantity when the trees attain an advanced age, exceptionally at 120 to 150 years, usually at 300 years. At the latter age the trees average 3 feet in diameter, and are considered to be mature and at the most profitable period for felling. Most of the timber is exported in the form of logs to Italy, where it is much esteemed, and is used for shipbuilding purposes generally. The logs are squared in the forest, all the sapwood being chipped off except a little at the four corners. Saleable logs must be at least 23 feet in length, and have a minimum section at the small end of 1 square foot. They fetch at Bastia, after a long haulage by road and railway, 36 to 40 francs per cubic metre, or about 10d. to 11d. per cubic foot. A small proportion of the timber in the forests is cut up into planks and joists for local use. The timber is very strong but heavy, and often contains a great deal of resin; when of the first quality it is considered to be as good as American pitch pine. It is very seldom used in France, and the reasons for this are not very clear.

I could obtain no information as to the collection of the seed of *Laricio* in Corsica, though I made inquiries when visiting the forests and also at the Conservator's office in Ajaccio. Mr. M. L. de Vilmorin, however, kindly informs me in a letter that the annual collection amounts to about three or four tons, of which his firm disposes of about one-half. The main localities for collecting are near Corte and Calacuccia, and at Vivario, which is not far from Vizzavona. The cones are put in the ovens which the villagers use for drying chestnuts, and as the amount of heat is not regulated with any precision, the seed is often over-heated. Though the crop of cones in the forest varies very much in different years, there has been no difficulty so far in procuring always a quantity of seed sufficient to meet the demand.

In Sardinia the Corsican pine is recorded from only one locality, the valley of the Flumini Maggiore, where it was collected by Moris.[1]

CALABRIAN PINE.—In Sicily the Corsican pine is common, according to Schouw,[2] on Mount Etna, where it forms woods between 4000 and 6000 feet. It is, however, in Calabria, in Sila and Aspromonte, that *Laricio* occurs in abundance, and there is little doubt that the tree here is identical with that of Corsica. Schouw,[2] who compared specimens from the botanical garden at Naples with the large Corsican pine growing in the Jardin des Plantes at Paris, is convinced of their absolute identity. Longo, who has recently written an article[3] on the flora of Calabria, gives five plates, reproductions from photographs, of the Calabrian forests, and a plate showing the variation in the cones; but he has added little to our knowledge of these interesting forests in his short description of them. He states that the finest one is the State forest of Gallipano. (A. H.)

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[1] Parlatore, *Fl. Italiana*, iv. 53 (1867). Moris's specimens, though without flowers or fruit, are probably *Laricio*, according to Parlatore.

[2] *Ann. Sci. Nat.*, III Ser., iii. 234 (1845).

[3] *Annali di Botanica*, iii. 1-17, tt. 1-6 (1905).

As I could find no account of this tree in its native country, and it was then little known in England; from the information I received from Signor Siemoni, chief of the Forest Department at Rome, I visited Cosenza, a town in Calabria, in April 1903. Here I was kindly received by Signor Carlo Pagliano, Inspector of Forests, who directed me to a village called Spezzano Grande, two hours' drive from Cosenza, from where I rode with Signor D. Greco, the sub-inspector, to the Sila Mountains, on which the largest forests of this tree now exist. The snow was still lying on the pass at about 4800 feet, but on the plateau beyond this it had melted except in shaded places. The forest is composed mainly of pine, here called Pino della Sila, Pino Rosso, or Pino Butello, mixed with beech in some places; but the forest has been considerably diminished by felling in former times, when the dockyards of Naples drew a large part of their timber from this district. The inspector told me that the only place he knew of where virgin forest of this tree still remained, was on a mountain called Femina Morte in the forest of Carigleone, in the district of Cattanzaro, 60 to 70 kilometres south-east of Cosenza. The average size of the trees which I saw being cut for the sawmill was not above 80 to 90 feet by 6 to 8 feet in girth, and smaller where they grew densely. These trees were 80 to 90 years old, and the heartwood, 10 inches in diameter, was reddish. In places where fire and cattle had not destroyed them, the natural reproduction was very good, and the seedlings when once established were making 2 to 3 feet of growth every year. The trees grew best in a south aspect on a soil which appeared to be decomposed granite, and, as far as I could learn, there is no limestone in this district. On my way back I visited Potenza in the Basilicata, whence, according to M. de Vilmorin's information, the seeds of the tree originally were introduced; but if the tree ever existed in the district, I could hear nothing of it.

Austrian Pine.—The Austrian pine has been the subject of a monograph by Prof. A. von Seckendorff[1] which gives very elaborate details of its literature, economy, and distribution in Austria, with maps and illustrations of remarkable trees in various places, which should be consulted by those who wish to know more than the brief résumé which I give. It occurs as a wild tree abundantly only in Lower Austria in an area extending from Mödling, near Vienna, south to near Pitten and south-west to Reichenrau, especially on the Alpine chalk formation, and attains an elevation of about 4000 feet. It attains a very great age, the rings of one felled near Stixenstein showing no less than 584 years, though the tree was only 65 feet high and about 6 feet in girth. In very rocky situations it grows so slowly that a tree near Mehadia was 270 years old, with a trunk only 8 feet high and about a foot in girth at the base.

Among the trees most remarkable for size may be mentioned a splendid tree at Vostenhofer (fig. ii. of Seckendorff) which is about 75 feet high and 21 feet in girth.

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[1] *Beiträge zur Kenntniss der Schwarzföhre* (Vienna, 1881).

It is divided into 4 stems near the ground and has a diameter of branches of about 25 yards. A tree called the Broad Pine at Mödling, near Vienna (fig. iii.), has an umbrella shape, very unusual in this species. It is only about 35 feet high but is no less than 60 feet broad. A tree called the Cross or Picture Pine in the Grossen Föhrenwalde (fig. v.) is considered the finest tree there. It measures about 65 feet high, of which two-thirds are clean trunk, and is 9 to 10 feet in girth at about 9 feet from the ground. The tallest specimen which is mentioned is not much over 90 feet, very much less than those I saw in Bosnia, some of which were considerably over 100 feet and probably over 120 feet, with clean stems to two-thirds of their height.

On good ground, however, in Austria this pine forms very fine timber; an example (shown on fig. viii.) at Gutenstein, near Zellenbach, is said to be 280 years old with an average height of 30 metres. Another of the same age at Fahrafelde is so like the growth of the tree in Bosnia that the photograph illustrating it (fig. ix.) shows the best form of this tree very well.

A hybrid between this tree and *Pinus sylvestris* was described by Reichhardt[1] as growing in the Forest of Merkenstein. (H. J. E.)

In Hungary, according to Pax,[2] the Austrian pine is only found at Mehadia on the lower Danube, where there are woods on dry stony mountain slopes. He noticed it, however, as a mere shrub at Tàlmacsel in the valley of the river Alt. In Styria its occurrence as a wild tree is doubtful. In Carinthia there are limited areas of this species on calcareous soil on the southern slopes of the Dobratsch. It is also recorded from Istria, Carniola, Croatia, and the island of Cherso. Ascherson[3] mentions one locality in Galicia. In Bulgaria[4] it grows in several localities in the Rilo-Dagh, and in the Rhodope Mountains above Stanimaka.

An excellent account of the distribution and forest conditions of this species in the western states of the Balkan peninsula is given by Beck.[5] The most extensive forests in this region lie in south-eastern Bosnia and extend across into Servia, in the district of *Novibazar*. Fine pine forests occur at Semec, on the slopes of the Lim valley, and on the hills between the Lim and Ceatina rivers. Between the middle part of the course of the river Drina in Bosnia and the river Morava in Servia the tree usually grows on palæozoic rocks, though it is occasionally seen on limestone. In Servia the forests of Austrian pine are less extensive, but extend from Ivica to Kapaonik. In middle Bosnia, where the tree is found growing on serpentine, and in western Bosnia, it is not at all common.

Elwes saw the tree growing abundantly in the valley of the Drina, as already mentioned in our account of *Picea Omorika*, and brought home a quantity of seed from this locality in 1901, which he distributed under the MS. name of *Pinus Laricio*, var. *bosniensis*, believing at the time that it was not the same variety as the common Austrian pine; but he now considers that the difference observed is no more than might be caused by a good soil and a more southerly and warmer climate.

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[1] *Verh. Zool. Bot. Ges. Vienna*, xxvi. p. 462.

[2] *Pflanzenverb. in Karpathen*, 104 (1898).

[3] *Syn. Mitteleurop. Flora*, i. 213 (1897).

[4] Velenovsky, *Flora Bulgarica*, 518 (1891).

[5] *Veg. Illyrischen Länder*, 139, 226 (1901).

In Herzegovina, according to Beck, the tree grows down the Neretva valley to the Plasa Planina and the southern slope of the Prenj Planina. In Montenegro it is comparatively rare, *Pinus leucodermis* having been often mistaken for it. It occurs scattered through Albania. In Dalmatia there are peculiar forests of Austrian pine, in which there is a dense undergrowth of evergreen Mediterranean shrubs and *Juniperus Oxycedrus*; and Beck describes the most remarkable of these, which occur at about 2500 feet elevation, on the peninsula of Sabioncello and the island of Brazza. The greatest altitude in these regions at which the Austrian pine was seen growing by Beck was 5300 feet on the west slope of Mount Dinara in south-western Bosnia, on the Dalmatian frontier.

In Greece, *Laricio*, probably of the Corsican variety, occurs in the mountains, often forming extensive woods, and Halacsy[1] mentions various localities in the provinces of Epirus, Thessaly, Eubœa, Ætolia, Peloponnesus, and in Crete. In Cyprus[2] *Laricio* is only met with on the summit of Troodos and on some crests to the west, at 4000 to 5000 feet altitude, just above the zone of *Pinus halepensis*, the two species mingling slightly together at the line of junction, as is the case in Corsica. Mr. Madon, who cut down a hundred trees, says that the timber is of no value, on account of the large amount of sapwood in immature trees, until it has reached the age of 250 years. Hartmann,[3] who has recently visited Cyprus, gives an elaborate account of the *Laricio* forest. He states that pure woods of this species are rarely met, as in its lower zone, from 4000 to 4500 feet, it grows mixed with *Pinus halepensis*; and above this, to the summit of Troodos, it is accompanied by *Juniperus fœtidissima*. It attains a height of 80 feet and a girth of as much as 16 feet.

In Asia Minor, according to Tchihatcheff,[4] it grows mixed with silver fir on Olympus in Bithynia at 2700 to 5000 feet altitude, and in the same province, on Mount Samanly, at 1600 to 2100 feet, and in the island of Thasos, where it forms with *Juniperus excelsa* a wood in the littoral region. He records it near Soma in the mountains of Mysia; in the valley of the Meander in Troas; between Mughla and Eskischer in Caria; in the Antitaurus, where it forms mixed woods with *Juniperus excelsa*, *Abies cilicica*, cedar, and oak; and in various localities in Pisidia, Isauria, and Cilicia.

In the Crimea[5] it grows on dry, poor, calcareous soil, forming woods on the western slopes of the mountain chain which extends along the coast of the Black Sea. The Crimean pine has been made a distinct variety, *pallasiana*, but it is probably identical with the Austrian pine.

According to Radde,[6] *Pinus austriaca*, as he terms it, is rare in the Caucasus. Steven discovered it in 1840 in the neighbourhood of Gelentschik; and Kusnezoff has since found it at a place called Wulanskaja, 35 kilometres south-east of Gelentschik, where there is a small open grove with sound trees attaining 2 metres in girth. Radde adds that it grows near the Black Sea at Bulanka. (A. H.)

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[1] *Consp. Fl. Græcæ*, iii. 452 (1904).

[2] *Forests of Cyprus; Parly. Paper, Cyprus*, No. 366 of 1881, *Encl. No.* 2, pp. 28, 34.

[3] *Mitt. Deutsch. Dendrol. Ges.* 1905, p. 172.

[4] *Asie Mineure*, ii. 497 (1860).

[5] Antoine, *Conif.* 6 (1840).

[6] *Pflanzenverb. in Kaukasusländern*, 169, 184 (1899).

CULTIVATION: CORSICAN PINE

Of all the conifers introduced into England, of which great expectations have been formed, none except the larch has shown such good results as the Corsican pine, which has proved a hardy and vigorous grower on almost all soils, and in almost all parts of Great Britain and Ireland. It has not, however, been long enough in the country to have established a position in the English timber market, and until it does it is difficult to say much of its economic value in the future. All accounts of this wood for estate purposes, though often used long before it has attained sufficient age to give the best results, agree in saying that though rough and knotty when grown singly, it is at least as good as Scots pine; probably more durable and stronger when used before maturity. Though it does not grow so fast on very barren and stony soils as the Austrian pine, it is far better from a timber point of view, and occupies less space. Its greatest defect is the difficulty of transplanting it when young on account of its very scanty root system, and as this often, indeed usually, entails considerable loss on both nurserymen and planters, the cost of getting a crop of *Laricio* established is very much higher than in the case of the Scots pine.

I have been most successful in avoiding a high death-rate by purchasing two-year seedlings with as many roots as possible from French nurseries in the spring, not before the middle of March, planting them at once in nursery rows on as sandy a soil as possible, and transplanting them to their permanent habitation in March or April, two years afterwards. But the plants will not then be large enough for the better class of land, and may require another transplantation before finally going out, by which time they will have cost 40s. to 50s. per 1000, and in some cases much more. The seedling has a very long primary root at first with very little fibre. By cutting this tap-root when the plant is only a year old, without lifting it from its seed-bed, it may be induced to make more roots, but if left unprotected for the first winter on wet or heavy soil a great many of the seedlings will be thrown out of the ground altogether. In my own ground I prefer to sow the seed in boxes, as their growth in the open ground is slow in comparison with what are raised in France. In order to overcome this difficulty some nurserymen adopt the practice of lifting all their one-year seedlings before winter sets in, and laying them in until spring, when they are lined out for two seasons' growth before being again transplanted.

I have on two occasions tried sowing the seed in the field where I wished the trees to grow, but with little success. The seedlings remain so small for the first two or three years that they cannot be seen among the grass, which soon covers them, and though this species seems to suffer less than any tree from being planted among coarse grass, it takes five or six years before the seedlings become conspicuous, and it will also be found that in some places they are too thick, and in others have entirely failed.

The Corsican pine is distasteful in the young state to hares and rabbits. An experiment to test this was made some years ago at Tortworth Court, where Lord Ducie planted a young *Laricio* in the centre of a rabbit warren, which, until the ground was covered with snow, the teeming population of the spot did not touch;

and even then, when starving, after an attempt to consume the young needles of the buds, they abandoned the experiment.[1]

Captain the Hon. R. Coke, a very close observer of trees, sends us the following notes from Holkham:—

"In distinguishing between *P. Laricio* and *P. austriaca*, one must apparently be guided rather by the general appearance and habit of the trees, than by any hard and fast rules. *Laricio* always looks well-bred in comparison with the coarseness of *austriaca*. Even when the former develops great limbs, coarse in themselves, the more delicate foliage will distinguish it from its Austrian relative. A good instance of this may be seen at Wolterton, where a fine specimen of each are growing side by side.

"Though the curved or twisted leaves are usually considered to mark the Corsican, yet this feature has been noticed in trees thoroughly Austrian in every other respect; moreover, some Corsicans have straight leaves. Sometimes the branches being produced in regular whorls up the stem is considered to be the mark of a *Laricio*, but all Corsicans do not follow this rule.

"When planting the sandhills at Holkham at various times between 1855 and 1890, Lord Leicester took the precaution of wiring in *austriaca* against rabbits and omitting to do so in the case of *Laricio*. This was done because it had been found that the *P. Laricio*, which were all raised from the seed of the old trees at Holkham introduced from Corsica in the early part of the 19th century, were unharmed by rabbits, which eagerly devoured *P. austriaca*. At the present time, of the trees growing on the sandhills, namely, *P. Laricio*, *P. austriaca*, *P. sylvestris*, *P. maritima*, practically the only one which reproduces freely is the *Laricio*, as the rabbits, though no longer numerous, seem to be able to distinguish this tree from its congeners, and leave it untouched. On the other hand, some trees bought as *Laricio* from an English nurseryman, which had every appearance of being genuine, were recently planted to fill up gaps in a belt at Holkham, and in this case the rabbits ignored the nurseryman's label, and made short work of the so-called *Laricio*."

Mr. J. D. B. Whyte, agent to Lord Iveagh, confirms the statement that rabbits will eat Austrian, and will not touch Corsican pines when planted together; but though the gamekeeper says that he has never anywhere seen a Corsican damaged by rabbits, Mr. Whyte does not think that the question has been fully tested at Elveden. This tree and the Austrian pine are sometimes planted in the Eastern counties as belts and hedges, but do not form so dense a shelter, or bear clipping so well as the Scots pine.

The Corsican pine is apparently less liable than some other pines to the ravages of insects and fungi. A specimen, however, sent in July 1905 to Kew by Mr. Wellwood Maxwell of Kirkennan, near Dalbeattie, showed a branch attacked by *Peziza Willkommii*, and Sir Herbert Maxwell showed me a similar case on a tree at Monreith.

On the sandhills of the Norfolk coast, near Holkham, are a number of Austrian and Corsican pines, planted on what appears to be pure drift sea sand, but Colonel Feilden suggested to me that their health and vigour may be due to the presence of lime, produced by sea-shells in the underlying beds. These trees were, as I was told by Mr. Donald Munro, forester to the Earl of Leicester, partly raised from seeds produced by the old trees in the garden at Holkham, and planted thirty to forty years ago, together with *Pinus insignis*, *P. Pinaster*, and *P. sylvestris*, to form a shelter belt and bind the loose drifting sand. Though some of the trees had preserved the peculiar leaf, colour, and habit of the Corsican and Austrian varieties, there were many others which could not be identified with certainty. A great number of seedlings have sprung up on the south or landward side of the hills, of which the largest were twelve to thirteen years old and 9 to 10 feet high; and many smaller ones of various ages were growing freely even in wet spots among tall rushes. Plate 115 shows the appearance of these seedlings. Rabbits and hares do not seem very abundant here, and I saw none of the Corsican seedlings barked, though one or two of the much scarcer *Pinasters* had suffered.

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[1] Hutchison, in *Trans. Scot. Arb. Soc.* vii. 55 (1875).

Mr. Richards, forester to Lord Penrhyn, is enthusiastic as to the merits of this tree, and writes to me that in North Wales it will grow where all other trees fail, that it stands wind better than any other conifer, and if planted in March and April few deaths take place. He grows it from seed collected in March and April and sown in May. He says there are many trees on the Penrhyn estate 80 to 90 feet high, but I did not see any quite so large as this. He considers that the timber is very good, better than that of any conifer he knows.

Captain Rutherford, agent to the Earl of Carnarvon at Highclere, also speaks very well of this tree, and sends me the dimensions of two not over seventy years old, one of which contains 201, the other 150 cubic feet, and a plank which he was good enough to give me certainly bears out his good opinion of the timber. It has pale red heartwood and yellowish sapwood, though it seems somewhat coarser in grain, and inferior to the wood of the Calabrian variety which I brought from Italy.

The Corsican pine[1] has not proved hardy in New England. It may be occasionally seen in the middle States, but there is no evidence, in large or old specimens, that this tree will really become a valuable acquisition for American plantations.

CULTIVATION: AUSTRIAN PINE

This tree is often sold as Corsican pine, but should never be planted knowingly except upon land where no better tree will grow, or to form a shelter belt on windy exposed hillsides of chalk or limestone, or on the sea-coast. For though a tree of extraordinary hardiness and rapid growth, it produces such a mass of large branches, and is so much inclined to fork, that its timber is extremely coarse, rough, and knotty, and would be unsaleable except at a very low rate or for pit-props. My father planted many of this tree, and I have found that though they make girth more rapidly than any other pine, they only thrive on sunny situations, where they have plenty of light and air; and though the great bulk of timber they produce in a short time may make them worth planting on such soils, yet I doubt the possibility of getting a sale at remunerative prices in most districts. In mixed or pure plantations their lower branches die off and leave large snags which are difficult and costly to remove, and though the very resinous nature of the wood may fit it for some purposes, I have never heard of its being utilised to any extent, except for pitwood. Austrian pine[1] has been planted very successfully as a shelter belt on the southern shore of Belfast Lough, about forty yards from the sea, in heavy clay; and behind it hardwoods and other trees are doing well. The tree has been extensively planted in many provinces of Austria and Hungary, mainly, according to Seckendorff, with the object of improving the soil for other trees; it has been recommended for this purpose on the poorer limestone soils of England, but the cost of so doing would in my opinion make the operation very unprofitable.

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[1] *Garden and Forest*, x. 471 (1897).

Though there is no reason why the Austrian pine should not sow itself in Great Britain, as the seeds ripen in hot years freely, yet I have never seen self-sown plants except near Sarsden Park, Oxfordshire, the property of Lord Moreton, and here only two or three young trees have sprung up on the rough limestone close to some old quarries.

The Austrian pine, according to Schübeler, is hardy in Norway as far north as Stenkjaer, at the upper end of the Throndhjem fjord. A tree in the Botanic Garden at Christiania, which Schübeler says was planted in 1842, is over 40 feet high, but was not a fine specimen when I saw it in 1906.

The Austrian pine[2] has been largely planted in the northern United States as an ornamental tree, and in youth is a handsome tree; but it generally succumbs to the attacks of boring insects before it has lost its bushy juvenile habit, and an Austrian pine in the United States more than fifty feet high is exceptional.

An account of Austrian turpentine,[3] which is derived from *Pinus Laricio*, is given by Georg Schmidt in an inaugural dissertation before the University of Berne in 1903.

CULTIVATION: CALABRIAN PINE

The Calabrian variety of *Laricio* was introduced into France by M. de Vilmorin in 1819-21, and a full account of its development at Les Barres was given in a catalogue of the trees cultivated there, published at Paris in 1878 by the Forest Department.[4] From this it appears that the tree has proved superior to other pines as a forest tree, and is especially recommended for planting in mixture with oak, which it rapidly surpasses in height, but without injuring it, on account of the slight development of its lateral branches. It has attained on this poor sandy soil a considerable size, and the young trees raised from seed grown there have preserved their superiority in the second and third generation. It produces seed abundantly there, but has the same defect as *P. Laricio* of being difficult to transplant. It is not easy to distinguish from the Corsican variety. M. Maurice de Vilmorin tells me that "in nearly every place where this variety has been planted in France, it has proved to be in comparison with true Corsican pines the larger and finer of the two."

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[1] *Journal of Forestry*, 1879, p. 165.

[2] *Garden and Forest*, ix. 453 (1896) and x. 470 (1897).

[3] *Harzbalsam von Pinus Laricio* (Bern, 1903).

[4] Cf. Pardé, *Arb. Nat. de Barres*, 61 (1906).

In Calabria the cones are gathered in December before they open, and kept till the following July, when they are spread out in the sun, and the seed falls out naturally, not being sown till the year after. I brought back in 1903 a sack of this seed which proved very good, and a large quantity of plants were raised from it by Prof. Fisher at Cooper's Hill, where they grew extremely well; better, as it seemed to me, than the Corsican pine, and much better than they did on my limestone soil. A number of these were sent to Culford, the seat of Earl Cadogan, in Suffolk, where his forester, Mr. Hankins, says that they stood the drought of 1906 very well on sandy soil. So far as I can see at present, the tree is quite hardy, and grows as fast or faster than the Corsican variety. It is equally difficult to transplant. Time alone will prove whether this tree has any economic value in England, but its superiority over the Corsican pine will be, I expect, only on soils deficient in lime, which the latter endures; and on granitic sand, in the warmer parts of England, it would certainly be worth a trial, either as a pure plantation, or, as recommended at Les Barres, in mixture with oak or beech.

A tree[1] reputed to be of the variety *calabrica* is growing in the Royal Botanic Garden, Belfast, and was 39 feet high by 3 feet in girth in 1905. It is said to be columnar in habit. A tree at Glasnevin, growing on the side of a hill, measured in 1906 41 feet by 4 feet, and is pyramidal in habit, with branches ascending at an angle of 45°. It is reported to have been planted in 1888, when four years old from seed.

REMARKABLE TREES

CORSICAN PINE.—One of the oldest, if not the oldest tree in England, stands near the entrance gate of Kew Gardens, and in 1903 measured 86 feet by 9 feet 3 inches. It was figured in the *Gardeners' Chronicle*, 1888, iv. 692, fig. 97, and according to J. Smith[2] was brought to England by Salisbury in 1814, when a seedling only 6 inches high.

In the pleasure ground at Holkham are three large trees which the Earl of Leicester believes to have been brought to England by a relative early in the nineteenth century, but the date of planting is somewhat uncertain. In 1907 they measured 85 feet by 11 feet, 80 feet by 9 feet 11 inches, and 80 feet by 9 feet 4 inches. Plate 116 shows two of these trees.

The tallest I have seen is at Brocketts, Herts, the seat of Lord Mountstephen, which, growing in a sandy soil and sheltered situation, was, when I measured it in 1905, no less than 119 feet by 8 feet 6 inches.

At Arley Castle, six fine trees, all over 100 feet high, measure 10 feet 8 inches, 9 feet 8 inches, 7 feet 9 inches, 8 feet 1 inch, 7 feet 8 inches, and 6 feet in girth respectively. Plate 117 shows the largest of these. Two of them have the habit of var. *Pallasiana*, but are indistinguishable in cones and foliage from the others. At Albury, Sussex, there is one over 100 feet high by only 6 feet 9 inches in girth. At Highclere, Berks, in Great Pen wood, on sandy soil, are the best plantation *Laricios* which I have seen. At about 70 years old they measure about 90 feet high by 7 to 8 feet in girth, and have clean boles for about half their height: several of these, however, are forked at some distance from the ground. At Bayfordbury there is a tree which in 1906 was 94 feet by 8 feet 7 inches, and in many other places we have seen specimens 80 to 90 feet high, which need not be specially mentioned.

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[1] Mentioned in *Gardeners' Chronicle*, 1870, p. 1537, as a prominent sort, distinct from the Caramanian or Corsican varieties.

[2] *Records of R. Bot. Gardens, Kew*, 286.

AUSTRIAN PINE.—Of the Austrian pine we have seen no specimens in England which rival the Corsican in height, though at Wolterton Park, Norfolk, the seat of the Earl of Orford, there are two large trees about 85 by 9½ feet, which show the characteristic difference in habit and in the colour of the leaves very clearly. From Grigor's account of this place in the *Eastern Arboretum*, p. 114, they seem to have been planted before 1840. Among the largest is a large spreading tree of this type at Nuneham Park, the seat of the Right Honourable L. Harcourt. Another at Canford Manor, Dorset, measured 83 feet by 9 feet; and at Williamstrip Park, on rather heavy soil, which this tree by no means seems to dislike, there is one of nearly the same dimensions, the largest I know in Gloucestershire.

Var. *Pallasiana.*—The best authentic specimen I know is a fine tree at Elveden, Suffolk, the property of Lord Iveagh. It is a flourishing tree with the foliage and cones of the Austrian variety, and measured when I saw it in 1907 94 feet by 8 feet 3 inches (Plate 118). Prof. A. Newton of Cambridge informs me that this tree was raised from seed sent by his eldest brother General Newton of the Coldstream Guards from Balaclava in 1854. The parent tree stood in a garden, which was used as a cemetery during the early days of the occupation of the Crimea. In the historic gale of 14th November 1854 the tree was blown down, and the graves covered with rubbish, and a cone was sent home in memoriam.

Other noteworthy trees are as follows:—

At Dropmore . . .	108 feet by 11 feet 5 inches	*fide* A. Henry,	1904.
,, Beauport . . .	85 ,, by 11 ,, 5 ,,	,, ,,	,,
,, Penrhyn . . .	95 ,, by 11 ,, 4 ,,	,, ,,	,,
,, Smeaton-Hepburn .	64 ,, by 6 ,, 5 ,,	,, ,,	1905.

At Chiswick House there is a good-sized tree, remarkable for having an immense growth of the character of what is usually called "witches' broom."

M. Gadeau de Kerville has figured[1] a very fine example of this pine, which was considered to be of the Calabrian variety by M. L. Corbiere (though this identification seems to me somewhat uncertain), which measured in 1894 35 metres (about 110 feet) high and 3.84 metres in girth. This tree is growing at Vatimesnil (Eure) in the park of M. de Vatimesnil, who believes it to have been planted by his ancestor about the year 1780. If this is correct, it is the oldest and probably the largest planted tree of the species either in France or England.

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[1] *Les vieux arbres de la Normandie*, fasc. iii. p. 317, plate ix.

PINUS LEUCODERMIS, Herzegovinian Pine

Pinus leucodermis, Antoine, *Oestr. Bot. Zeitung.* xiv. 366 (1864); Beck v. Mannagetta, *Weiner Illust. Gartenzeit*, 1889, p. 136, and *Veg. Illyrischen Länder*, 353 (1901); Ascherson u. Graebner, *Syn. Mitteleurop. Flora*, i. 212 (1897).

Pinus Laricio, Poiret, var. *leucodermis*, Christ, *Flora*, l. 81 (1867); Masters, *Journ. Linn. Soc.* (*Bot.*) xxxv. 626 (1904).

An alpine tree attaining rarely 90 feet in height and 6 feet in girth. Bark ashy grey, fissuring into irregular plates, averaging 6 inches in length and 3 inches in breadth. Buds like those of *P. Laricio*, but darker brown in colour. Young branchlets glaucous. Leaves in pairs, persisting five or six years, densely covering the branchlets, except at the base of each year's shoot, which is bare for a short distance, forming an apical cup-like tuft, and on the rest of the branchlet directed forwards and slightly outwards; the two leaves in each bundle only slightly divergent; dark green, stiff, short, 2 to 3 inches in length, ending in a sharp cartilaginous point; basal-sheaths as in *P. Laricio.* According to Koehne,[1] the structure of the leaf differs from *P. Laricio* in the resin-canals not being surrounded by stereome cells; and Masters states that the hypoderm projects in wedge-shaped masses into the substance of the leaf, which is not the case generally in forms of *Laricio.*

Cones short-stalked, ovoid-conic, with a flat base, about 3 inches long, resembling generally those of *Laricio*, but differing in the uniform dull brown colour of the whole cone, the umbo being of the same colour as the rest of the apophysis. The lower scales of the cone have very prominent pyramidal apophyses, and the umbo has a well-marked short spine directed backwards. Concealed part of the scales light brown on both surfaces. Seeds as in *P. Laricio.* (A. H.)

Pinus leucodermis was discovered in 1864 by Maly, who introduced it into cultivation the same year in the Belvidere, Vienna. The best account of the tree is given by Beck, who considers it to be specifically distinct from Laricio, and names it the Panzerföhre or Smré of the Herzegovinians. It is found in four distinct areas in Bosnia, Herzegovina, and Montenegro; and as the most southerly of these is on the Montenegro-Albanian frontier (lat. 42° 25′), it is probable that it also grows on the Peristeri[2] mountain, which lies west of Monastir in Albania. The most northerly locality (lat. 43° 40′), where it was discovered by Beck, is the Prenj Planina in the heart of Herzegovina. Here it occupies an area of about sixty kilometres in diameter, surrounding the western part of the Bjelasnica mountain, and forms a coniferous belt at from 4600 to 5500 feet elevation, rising solitary or in small groups to 5800 feet. Another area is the Bjela Gora, where the political boundaries of Bosnia, Montenegro, and Herzegovina unite around Mount Orjen. Reiser found it also in the Sinjavina Planina in Montenegro. Its occurrence in Servia is not yet established.

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[1] *Deutsche Dendrologie*, 37 (1893).

[2] This must not be confused with another mountain of the same name, east of Janina in the Pindus range.

It seems to resemble *P. Cembra* in its way of growth, and is confined to mountains of Triassic and limestone formation, where it forms a zone of scattered forest just below the limit of trees, usually not more than 1000 feet in depth, and finds its lowest level at 1000 metres on the Preslica planina, according to Reiser, near the railway station of Bradina; ascending on the Prenj and Orjen mountains to 1700 or 1800 metres. At the lowest elevation it is mixed with beech; at the highest with *P. montana, Juniperus nana,* and *J. sabina.*

In some places at the upper levels, where the snow lies very deep, it becomes very stunted, not rising more than 2 to 4 metres from the ground, but does not assume the procumbent habit of *P. montana.* It roots itself so firmly on the dry bare rocks of these mountains that no wind can hurt it, and it endures the burning sun and bitter winds of this region without injury. I am indebted to Herr Reiser of Serajevo for the photographs showing the habit of this tree (Plate 119).

In the upper Idbar valley there is a forest where *P. leucodermis* grows mixed with spruce, silver fir, Austrian pine, and yew, as well as with beech, ash, sycamore, *Pyrus torminalis*, and *Acer obtusatum.* Its smooth grey bark,[1] divided into irregular segments, makes it very easy to distinguish from the Austrian pine, but Beck does not think the name of whitebark pine so applicable as that of Panzerföhre or armoured pine. The tree attains under favourable circumstances a height of 90 feet, with a diameter of 6 feet at the age of 294 years.

Of its timber Beck says nothing, but a story which was current in Bosnia when I was there in 1899, and which doubtless has some foundation, leads one to suppose that it is very hard. A Bosnian Turk was said to have bought a lot of trees of this species, which he felled and floated down the Narenta, and sold the timber as that of larch.

With regard to the occurrence of this species elsewhere, Christ described as a new species, *Pinus Heldreichii*,[2] specimens which were collected on Mount Olympus in Thessaly. Afterwards, in a letter to Dr. Masters, he stated that this is only a remarkable alpine variety of *Pinus Laricio*, very reduced, and approaching in some respects *Pinus montana.* Halacsy[3] considers that this tree, which grows on Mount Olympus in company with the ordinary form of *Laricio* and with *Abies Apollonis*, is identical with *Pinus leucodermis.*

A tree referred to this species has been recently found in southern Italy by Dr. Biagio Longo. He mentions[4] two localities, the alpine zone of the Calabrian Apennines from Orsomarso to Mount Montea, and the mountain of La Spina in the province of Basilicata, where it grows in the zone of the beech, and rivals that tree in thickness of trunk; but the foresters in the Sila mountains do not recognise this as a distinct species, or did not know of its discovery when I was there in 1903.

Seeds were sent by Beck to Kew in October 1890; and five plants were raised, which have grown with remarkable slowness, being only 9 to 12 inches high in 1901.

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[1] The bark is figured in Hempel u. Wilhelm, *Bäume u. Sträucher*, i. 161, fig. 84 (1889).

[2] Christ, in *Verh. Naturf. Ges. Basel*, iii. 549 (1863), but later, in *Flora*, l. 83 (1867), he states that *Pinus Heldreichii* is identical with *P. leucodermis*, which he considers to be only an alpine variety of *P. Laricio.*

[3] *Consp. Fl. Græcæ*, iii. 453 (1904).

[4] *Annali di Botanica*, iii. 13, 17 (1905), iv. 55 (1906).

One of these trees, planted out in a bed near the pagoda, is barely 3 feet high at present. Another which was sent to Colesborne was planted in a high exposed situation in my park, where it grows very vigorously on oolite soil.

When in Bosnia, on my way to collect seeds, I was obliged to return home suddenly, but my companion, Mrs. Nicholl, who visited the Prenj mountain, procured a quantity of seeds which I sowed in 1902, and which have grown as fast as either the Corsican or Austrian pines, and look more healthy and vigorous on my soil than any other pine I have raised. They form a much better root-system when young than either the Austrian or Corsican pine, and in consequence are much more easy to transplant. I moved a number in September last just before a period of drought, and they have passed through a severe winter with very few deaths; I therefore believe that the tree will be a good one for planting in dry limestone soils, and may have a greater ornamental if not economic value than the Austrian pine.

(H. J. E.)

GYMNOCLADUS

Gymnocladus, Lamarck, *Dict.* i. 773 (*ex parte*) (1783); Bentham et Hooker, *Gen. Pl.* i. 568 (1865).
Guilandina, Linnæus, *Gen. Pl.* 518 (*ex parte*) (1742).

DECIDUOUS trees, belonging to the division Cæsalpinieæ of the order Leguminosæ. Branches stout and without thorns. Leaves large, alternate, bipinnate, the number of pinnæ being either odd or even; pinnæ and leaflets usually alternate. Stipules foliaceous, early deciduous.

Flowers polygamous or diœcious, terminal or axillary, in racemes or racemose corymbs, on long pedicels. Calyx tubular, lined with a glandular disc, ten-ribbed, five-lobed, the lobes narrow and nearly equal. Petals four to five, slightly unequal, imbricated, inserted on the margin of the disc, spreading. Stamens ten, free, shorter than the petals and inserted with them, those opposite the calyx lobes longer than the others; anthers oblong. Ovary rudimentary or absent in the staminate flowers, sessile or sub-sessile in the polygamous and pistillate flowers; style short and dilated above obliquely into a two-lobed stigma.[1] Ovules four or numerous.

Pod oblong, thick, coriaceous, dark brown, flattened, beaked at the apex, slightly curved or falcate, on stalks ½ to 2 inches long, pulpy between the seeds. Valves two, narrowly winged on the margins. Seeds on long slender stalklets; seed-coat thick and bony; embryo surrounded by a layer of horny albumen.

Only two species are known, one occurring in China and doubtfully hardy in this country, the other a native of N. America and cultivated in England.

GYMNOCLADUS CHINENSIS, CHINESE SOAP TREE

Gymnocladus chinensis, Baillon, *Compt. Rend. Assoc. Franç. Avanc. Sc.* 1874, p. 418, t. 4, and *Bull. Soc. Linn. Paris*, 1875, p. 33; Oliver, in Hooker, *Icon. Plant.* xv. 9, t. 1412 (1883); Hemsley, *Journ. Linn. Soc* (*Bot.*) xxiii. 207 (1887).
Dialium sp. ?, Hanbury, *Science Papers*, 238, fig. 5 (1876).

A tree attaining 40 feet in height. Young shoots rusty pubescent. Leaves 1 to 3 feet long; pinnæ alternate or sub-opposite, all composed of numerous (twenty to twenty-four) leaflets, which are ¾ to 1½ inch long, alternate, oblong, rounded at the base, obtuse or rarely acute at the apex, densely silky appressed pubescent beneath, on short pubescent petiolules; rachis densely pubescent, swollen at the base, and forming a conical sheath enclosing the bud.

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[1] The stigma of *Gymnocladus chinensis* is not correctly shown in Hook. *Ic. Pl.* t. 1412.

Flowers polygamous, in pubescent racemes, those with staminate flowers shorter than the others. Calyx pubescent, with subulate lobes. Petals oval-oblong. Ovary glabrous with four ovules. Pod, 4 inches long by 1½ inch broad, glabrous. Seeds, two to four, black, globose, smooth, ¾ inch in diameter.

This tree is rather rare in China, though specimens have been collected in the provinces of Anhwei, Kiangsi, Chekiang, Hupeh, and Szechuan. Near Ichang it grows at 1000 to 2000 feet altitude. The pods, called *fei-tsao*, after being steeped in water, produce a liquid esteemed for washing the hair and cleansing silk articles.

Plants[1] were raised at Kew from seeds sent by me in 1888; but died in a year or two. Seeds, which could be easily procured from Shanghai, where they are sold in the shops, might be tried in the warmer parts of England and Ireland, as the tree is worth cultivating on account of its beautiful delicate foliage. (A. H.)

GYMNOCLADUS CANADENSIS, Kentucky Coffee Tree

Gymnocladus canadensis, Lamarck, *Encycl.* i. 733 (1783); Loudon, *Arb. et Frut. Brit.* ii. 656 (1838).

Gymnocladus dioicus, Koch, *Dendrologie*, i. 5 (1869); Sargent, *Silva N. Amer.* iii. 69, tt. 123, 124 (1892), and *Trees N. Amer.* 554 (1905).

Guilandina dioicus, Linnæus, *Sp. Pl.* 381 (1753).

A tree attaining in America over 100 feet in height and 9 feet in girth. Bark fissured, dark grey, and roughened by small persistent scales. Young shoots covered with short pubescence. Leaves (Plate 125, fig. 4) 1 to 3 feet long, with 5 to 11 pinnæ, which are usually alternate but occasionally sub-opposite, the two or rarely the four lower pinnæ simple, the others composed of six to fourteen alternate pinnate leaflets. Leaflets 2 to 3 inches long, on pubescent stalklets, ovate, rounded at the base, acuminate at the apex, entire and ciliate in margin; under surface with scattered long hairs.

Flowers usually diœcious, the inflorescence of the staminate tree a short racemose corymb, that of the pistillate tree a long raceme. Calyx tomentose, with five narrow oblong lobes. Petals five, tomentose, longer and broader than the calyx-lobes. Ovary pubescent; ovules ten or more.

Pod, 6 to 10 inches long by 1½ to 2 inches broad, minutely pubescent. Seeds, five to ten, surrounded by dark-coloured sweet pulp, ovoid, ¾ inch long, and covered by a hard dark brown shell.

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[1] Cf. Nicholson, *Garden and Forest*, 1889, p. 139.

In the young leaf[1] of *Gymnocladus canadensis*, the rachis is prolonged an inch or more above the insertion of the upper pinnæ; and the axes of the pinnæ are similarly prolonged beyond the leaflets. These terminal appendages are very slender and tendril-like, and disappear before the leaf attains its full size. They have been supposed to be rudimentary tendrils, such as occur normally in a developed state in many leguminous plants; but they may represent simply degenerate terminal leaflets.

Sargent states that this species is diœcious; and that in order to obtain fruit male and female trees must be close together. C. M. Hovey,[2] however, writing from Boston, states that he knows a solitary tree, no other being within two miles, which produces fruit and fertile seeds, from which he has raised many plants. The so-called pistillate flowers have stamens, which doubtless are usually not fully developed; but it is possible that in some cases they may produce good pollen.

The flowers[3] in America are visited by bees, which are attracted by the nectar secreted by the inner wall of the calyx tube.

IDENTIFICATION

In summer the foliage of the tree is unmistakable. In winter the fewness of the branches and the stoutness of the branchlets, which are very short in adult trees, are remarkable. The latter show the following characters:—

Twigs coarse, grey, glabrous, with numerous small brown lenticels and wide, circular, orange-coloured pith. Leaf-scars large, obcordate, slightly oblique on prominent pulvini, with a narrow raised yellowish margin and a whitish convex surface, marked by three to five irregular tubercles, which are the scars of the vascular bundles. Buds very small; two to three vertically superposed, in the axil of each leaf-scar, the lower one rarely developing; projecting slightly out of circular depressions in the bark, which form pubescent rings around the buds. Each bud shows two to three minute scales, which become accrescent and green in the spring at the base of the shoots. No true terminal bud is developed, the tip of the branchlet falling off in summer and leaving at the apex of the twig a circular scar.

DISTRIBUTION

The Kentucky Coffee tree, though occupying a wide area in North America, is nowhere common. It is found scattered amongst other trees on hillsides where the soil is rich, and in alluvial land beside rivers. It is met with in central

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[1] Cf. B. D. Halstead, in *Torreya*, ii. 5 (1902).

[2] *Garden*, xiv. 240 (1878).

[3] Robertson, *Trans. Acad. Sc. St. Louis*, vii. 165 (1897).

New York and western Pennsylvania, through southern Ontario and southern Michigan to the valley of the Minnesota River and to eastern Nebraska, eastern Kansas, south-west Arkansas, the Indian territory, and central Tennessee.

The tree is noted[1] in America for its habit of suckering from the roots when it is cut down. After a tree is felled the ground around to a distance of often 100 feet becomes filled with numerous suckers; and this is one of the ways in which the trees are reproduced in the American forests. The tree never develops any epicormic branches, and is very seldom attacked by any insect or fungus.

(A. H.)

An article by Sargent in *Garden and Forest*, ii. p. 75, gives an excellent account of this tree, and states that by far the largest and handsomest that he has seen was planted in 1804 directly in front of the historical Verplanck mansion at Fishkill-on-Hudson, and was, in 1889, 75 feet high and a little over 10 feet in girth below the point where it divides into three stems at 3 feet from the ground. Though it was struck by lightning in 1887, the tree is an extremely graceful and well-shaped one, as the picture shows.

The tree grows well as far north as Ottawa, where I saw two spreading trees about 40 feet high, planted in front of Rideau Hall, the residence of the Governor-General. The gardener informed me that they were the latest trees to come into leaf, and, though they flowered in good seasons, produced no fruit.

At Mount Carmel, Illinois, I measured a tree in the forest 92 feet by 8 feet, one of the few remaining relics of the splendid trees described by Ridgway, one of which was 109 feet high, with a clear stem 76 feet to the first limb, but only 20 inches across the stump. Dr. Schneck has measured one in the same locality no less than 129 feet high. It is, however, nowhere an abundant tree in this district, but grows scattered through the richer bottoms.

The tree from which a specimen log in the Jessup collection in the American Museum of Natural History was cut, grew not far from St. Louis, and although only 18 inches in diameter was 105 years old. This represents the average rate of increase of the tree growing naturally in the forest, cultivated trees in favourable conditions growing much more rapidly.

CULTIVATION

Gymnocladus canadensis was introduced into England by Archibald, Duke of Argyll, who had a tree in cultivation[2] at Whitton in 1748. This tree was afterwards removed to Kew, on the establishment of the gardens there by the Princess of Wales, mother of George III., who obtained it and many other interesting trees as a present from the Duke of Argyll in 1762. This tree died[3] about 1870; and as old trees reported by Loudon at Syon and elsewhere cannot now be found, it goes to show that the tree lives little over 100 years in England.

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[1] *Garden and Forest*, vii. 358 (1894).

[2] Aiton, *Hort. Kew.* v. 400 (1813).

[3] J. Smith, *Dict. Econ. Plants*, 235 (1882), mentions this tree as if it was still living in 1882; but according to Nicholson it had died several years previously to that date.

According to Nicholson,[1] it is very easy to transplant, and bears drought well. It is propagated either by seeds or by root-cuttings. Pieces of the roots, 4 to 5 inches long, placed in prepared beds and kept moist, will develop in the first year into plants three or four feet high. Some of the cuttings, however, will not start into growth until the following year.

I have raised seedlings from American seeds, which, being large and hard, should be soaked in warm water for some days before sowing. The seedlings grow slowly, and should be kept under glass for a year or two before planting out.

In spite of Loudon's assertion to the contrary, it appears to flower very rarely in England, the only record being at Claremont, where Mr. Burrell[2] says it produces flowers freely early in summer. Pods have never been produced, so far as we know, in this country.

It is a rare tree in cultivation; but though stiff and peculiar in habit, it is not at all ungainly when well-grown, even when bare of leaves. It comes into leaf very late in the season, and it drops its leaves early in autumn, the stalks, however, often remaining on the tree for weeks. The foliage, like that of many leguminous plants, shows the phenomenon of sleep, the leaflets drooping and closing together soon after sunset in summer.

Remarkable Trees

There are two trees at Claremont, which were about 55 feet high in 1888. When I measured them in 1907 the largest was 60 feet by 6 feet 7 inches, and seemed quite healthy; the other was broken.

A tree at Chiswick House measured, in 1903, 53 feet high by 3½ feet in girth. Another at Barton, Suffolk, was in 1904 57 feet high by 5 feet 2 inches in girth at two feet from the ground, and divided above this into two stems. In the Botanic Garden at Cambridge there is a good specimen, which was 45 feet by 3 feet 9 inches in 1906. There are three smaller trees in the Oxford Botanic Garden.

At Kayhough, Kew, in the garden of Mr. Charles Wright, there is a healthy and well-shaped tree, which was in November 1905, 40 feet high by 2 feet 9 inches in girth, with a bole of 6 feet, dividing into two main stems. This tree was purchased from a nurseryman at Kingston in 1878, when it was said to be twenty-two years old, and was then about two-thirds its present height. After transplanting, it made no growth for three years; but since then it has grown steadily though very slowly, and has not been injured in any way by severe winters, though it has never flowered. It has been much surpassed in rate of growth by an Ailanthus in the same garden. There is a tree of about the same size growing close to Mr. Clarke's house at Andover, Hants, which is fifty to sixty years old and measures 43 feet by 2 feet 10 inches. There are several small trees in Kew Gardens, the largest one being near the main entrance.

It seems evident that the tree, to attain a large size, requires a much greater degree of summer heat than it gets in England, for in the south of France it becomes a splendid tree. I saw in the Museum Gardens at Chambery, in the grounds of the Castle formerly belonging to the Dukes of Savoy, a tree which, though forked near the ground, had two tall clean trunks each about 100 feet by 5 to 6 feet. The leaves were only just appearing on 18th May, and many of the large bean-like pods full of greenish pulp, which had fallen in the winter, lay on the ground. Seeds from these pods germinated, but the seedlings, with one exception, withered soon afterwards. It is not uncommon in Savoy, and I saw a fine specimen, 81 feet by 9 feet 6 inches, in the Public Gardens at Aix-les-Bains, which in October 1906 had ripe pods on it. It is known in France by the name of "Bonduc."

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[1] *Garden*, xxiv. 29 (1883).

[2] *Garden*, xxxiii. 229 (1888) and xlv. 404 (1894).

In the old Botanic Garden at Padua a splendid tree was in 1895, according to Prof. Saccardo,[1] 135 years old, 21 metres high, and 2.60 metres in girth. When I saw it in 1905 the trunk was broken off at about 12 feet, but long shoots, which were in flower, had been produced from the stump. (H. J. E.)

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[1] *L'Orto Botanico di Padova* (1895).

CEDRELA

Cedrela, Linnæus, *Gen. Pl.* 109 (1764); Bentham et Hooker, *Gen. Pl.* i. 339 (1862).
Toona, Roemer, *Synops.* i. 131 (1846).

TREES, belonging to the order Meliaceæ, with unequally pinnate leaves, without stipules, and composed of numerous opposite or sub-opposite stalked leaflets.

Flowers in panicles, perfect, regular Calyx short, four- to five-cleft. Petals, four to five, nearly erect, imbricated, free. Stamens, four to six, free, inserted at the top of a four- to six-lobed hypogynous disc; filaments subulate, anthers versatile. Ovary sessile on the disc, five-celled, each cell containing in two series eight to twelve pendulous ovules. Fruit, a coriaceous or woody capsule, composed externally of five valves, and almost filled up internally by a central column, between which and the valves are five thin cells, containing the seeds, which are numerous, compressed, and with one or two wings.

The genus is divided into two sections:—

I. *Eu-Cedrela.*—Seed with a single wing on its lower side. Nine species in tropical America.

II. *Toona.*—Seed with either two wings, one at each end, or with a single wing above. Eight species in India, Indo-China, China, and Australia, all in tropical regions except *Cedrela sinensis.*

CEDRELA SINENSIS

Cedrela sinensis, A. Jussieu, *Mém. Mus. Par.* xix. 255, 294 (1830): *Rev. Hort.* 1891, p. 573, figs. 150, 151, 152; Hemsley, *Journ. Linn. Soc.* (*Bot.*) xxiii. 114 (1886).
Toona sinensis, Roemer, *Synops.* i. 138, 139 (1846); Diels, *Flora von Central China*, 425 (1901).
Ailanthus flavescens, Carrière, *Rev. Hort.* 1865, p. 366.

A tree of moderate size, attaining in China a height of 60 to 70 feet. Bark scaling off in narrow longitudinal strips, 1 to 2 inches in width, and leaving exposed in parts the reddish inner bark below. Young shoots covered with minute pubescence. Leaves (Plate 125, fig. 7), large, 1 to 2 feet in length. Leaflets, eleven to nineteen, about 4 inches long, on pubescent stalklets (nearly $\frac{1}{4}$ inch long), opposite or sub-opposite, divided into two unequal parts by the midrib, the upper part larger and rounded at the base, the other part usually cuneate at the base; apex caudate-acuminate; margin repand, minutely ciliate, distantly and minutely serrate or with occasional short teeth; nerves, fifteen to eighteen pairs, usually dividing and forming loops close to the margin; upper surface dark green, glabrous; lower surface pale green, glabrescent.

Flowers fragrant, in pubescent terminal panicles, which are a foot or more in length; pedicels short. Calyx with five short, rounded, ciliate lobes. Petals five, white, oblong, sub-cordate at the base, converging at the apex. Stamens five, alternating with five staminodes. Fruit about an inch long; valves, opening longitudinally from above downwards. Seed with an oblong wing attached to its upper side, the wing two to three times as long as the body of the seed.

In summer the large pinnate leaves give the tree much the appearance of Ailanthus; but the bark is different, and the leaflets of Cedrela are devoid of the glandular teeth near the base, which are so characteristic of Ailanthus. In winter the following characters are available (Plate 126, fig. 2):—

Twigs stout, brown, minutely pubescent; lenticels small, scattered; pith white, circular in section. Leaf-scars large, alternate, slightly raised, obcordate or oval, with five bundle-dots. Terminal bud, much larger than the others, broadly conical, of four to six triangular scales, which are swollen externally and hollowed internally, brown, shining, with acuminate pubescent tips. Lateral buds minute, solitary, inserted immediately above the leaf-scars, hemispherical, showing three to five shining brown scales.

Lubbock,[1] who gives a detailed account of the structure and development of the buds, the scales of which are modified leaves, states that the terminal bud usually dies in winter, but sometimes lives, and then is always later in developing in spring than the lateral buds.

Cedrela sinensis is a native of northern and western China. It is very common in the neighbourhood of Peking, and was found in Kansuh, beyond the Great Wall, by Piasetski. According to von Rosthorn and Wilson, it is wild in the forests of the province of Szechuan. It is commonly cultivated in central China, where it never attains a great size, mainly because the Chinese spoil its growth by lopping off in spring the young shoots, which are much esteemed as food. These are eaten after being chopped and fried in oil. The tree is known to the Chinese as the *hsiang-ch'un.*[2] The timber is good, reddish in colour, and often used in making furniture.

The tree was first made known to Europeans by Père d'Incarville, who sent dried specimens from Peking to Paris in 1743. In China it has been well known from classical times, and references to it occur in the earliest Chinese literature.

Cedrela sinensis was introduced in 1862 by Simon, who sent a living plant from Peking to the Museum at Paris, which was described by Carrière in 1865 as *Ailanthus flavescens.* On the tree flowering in 1875 it was recognised to be *Cedrela sinensis.* This tree, which was planted in the nursery attached to the garden of the Museum, had attained in 1891 a height of 40 feet; and, when Elwes saw it in 1905, it was very little taller, and about 4 feet in girth.

Many trees have been raised in the vicinity of Paris, both by seed and by root-cuttings; and it appears to be perfectly hardy in the north of France, having sustained without injury the severe winter of 1879-1880. Its large fragrant foliage renders it perhaps more suitable than the Ailanthus for planting in towns. It is said by Nicholson to be now largely used in Holland for that purpose.

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[1] *Journ. Linn. Soc.* (*Bot.*), xxx. 478 (1894).

[2] Cf. name given to *Ailanthus*, p. 32.

The tree is rather rare in England, and we have seen no specimens remarkable for size. There is a tree in Kew Gardens which measured in November 1905 33 feet by 2 feet 4 inches. This is probably of the same age as an Ailanthus of equal height growing beside it. A tree much about the same size is growing and thriving in Messrs. Veitch's Nursery at Coombe Wood. Mr. Cassels informs me that young trees of Cedrela are planted in some of the London County Council parks, as Meath Gardens and Bethnal Green.

Cedrela sinensis is also cultivated in the United States,[1] where a tree flowered at Meehan's nurseries, Germanstown, in 1895. Another only eight years old had attained in the same year 20 feet in height in western Virginia. Professor Sargent thinks it might be used as a street tree in New England, though introduced plants have proved rather tender in that climate. It has frequently flowered in France, but has never produced fruit there. There is no record of its having flowered as yet in England.

Mouillefert[2] speaks of this tree as one which, in his opinion, has a great future in Europe on account of the high quality of its wood, which he compares to that of mahogany and that of the so-called cedar of the West Indies (*Cedrela odorata*). He says that the tree grows fast from seed, attaining 5 feet in the third year, and adds that on calcareous soil of middling quality at Grignon a tree about twenty-five years old measured 10 metres high. (A. H.)

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[1] *Garden and Forest*, 1896, pp. 260, 279.

[2] *Principales Essences Forestières*, 471, 472 (1903).

PTEROCARYA

Pterocarya, Kunth, *Ann. Sc. Nat.*, sér. I. ii. 345 (1824), Bentham et Hooker, *Gen. Pl.* iii. 399 (1880).

Deciduous trees belonging to the order Juglandeæ, with large, alternate, compound, imparipinnate leaves; leaflets serrate; stipules absent. Buds scaly or naked, the lateral ones often multiple, two to three in a vertical row above the insertion of the leaf. Pith chambered. Flowers monœcious, numerous in long pendent catkins. Male catkins usually several, arising singly in the leaf axils; in some species (*caucasica, stenoptera*) lateral on the preceding year's shoots, with an occasional catkin on the current year's shoot; in other species (*rhoifolia, Paliurus*) all on the new shoots. Stamens nine to eighteen in several series on the axis of a three- to six-lobed scale, to which a bract is adnate on the back, the scale representing two bracteoles and one to four perianth segments. Female catkins solitary, terminating the young shoot. Female flowers with a bract and two bracteoles at the base; perianth four-lobed, adnate to the ovary, which contains one ovule, and is surmounted by a short style, divided above into two papillose stigmatic divisions. Fruit catkins long, with numerous nut-like fruits, which have in most species two lateral wings, in one species a single orbicular wing all round, due to the enlarged bracteoles of the flower, the bract persisting little changed at the base of the fruit. Nutlet, with a thin pericarp and a hardened endocarp, the latter divided below into four imperfect cells, and containing one seed, which is four-lobed below. Cotyledons bi-partite, each division being again deeply divided, forming four linear segments; carried above ground in germination.

Pterocarya and Juglans have similar foliage, and agree in the chambered pith of the twigs. They are readily distinguished when in fruit, that of Pterocarya being always small and winged. When specimens in leaf only are obtainable, the best mark of distinction lies in the buds, which in Pterocarya are either without scales or are enclosed in a long conical beaked funnel-like covering, composed of membranous scales—differing in either case from the short buds of Juglans with two to three external scales.

Seven species of Pterocarya are known, occurring in Persia, the Caucasus, China, Tonking, and Japan. A hybrid species has been obtained in cultivation, which will be described under *P. caucasica.* The seven species which occur in the wild state may be arranged as follows:—

SECTION I. CYCLOPTERA, Franchet, *Journ. de Bot.*, 1898, p. 318.

Fruit surrounded by an orbicular wing, composed of the connate bracteoles, which cover the nutlet at the base.

1. *Pterocarya Paliurus*, Batalin, *Act. Hort. Petrop.* xiii. 101 (1892); Franchet, *loc. cit.*; J. H. Veitch in *Journ. R. Hort. Soc.* 1903, xxviii. 65, fig. 26. China: mountains of Szechwan, Hupeh, and Chekiang.

Tree 40 feet. Twigs pubescent and glandular. Buds naked. Leaf-rachis villous or pubescent, not winged. Leaflets seven, coriaceous, oblong-ovate, with sub-acute apex, glabrous below except along the midrib. Fruits samara-like, the nutlet in the centre of an orbicular wing, 2 inches across, several on a raceme a foot long.

This species was introduced in 1903 by Mr. E. H. Wilson from the mountains of Central China; and young plants, which seem perfectly hardy, are now growing at Messrs. Veitch's Nursery, Coombe Wood. The tree when in fruit presents a remarkable appearance, and is well worth trial, as it should prove hardier than *P. stenoptera*, which grows at a lower level.

SECTION II. DIPTERA (*Sectio nova*).

Fruit with two lateral wings, the developed bracteoles, which do not cover the nutlet at the base.

* *Buds naked, without scales.*

2. *Pterocarya stenoptera*, C. DC. China, Tonking.

Tree 60 feet. Twigs bristly-pubescent. Leaf-rachis winged. Leaflets nine to twenty-five, coriaceous, underneath glabrescent with pubescent tufts in the axils of the nerves. Fruit with long lanceolate upright glabrous wings. In cultivation. See description below.

3. *Pterocarya hupehensis*, Skan, *Journ. Linn. Soc.* (*Bot.*), xxvi. 493 (1899). China: mountains of Hupeh.

Small tree about 30 feet. Twigs glabrous. Leaf rachis not winged, glabrous except for some tomentum near its insertion. Leaflets five to nine, lanceolate; under surface with brown scurfy scales and glabrous except for stellate rusty tomentum in the axils of the nerves. Fruit minutely glandular, with sub-orbicular wings, ½ inch diameter. Introduced by Mr. E. H. Wilson in 1903. Young plants are now growing at Coombe Wood and seem to be perfectly hardy.

4. *Pterocarya Delavayi*, Franchet, *Journ. de Bot.* 1898, p. 317. China: mountains of Yunnan.

This species, which I have not seen, appears closely to resemble the last, differing mainly in the fruits being covered with short hairs. Not introduced.

5. *Pterocarya caucasica*, C. A. Meyer. Persia, the Caucasus.

Tree attaining 100 feet. Twigs glabrous except for some pubescence at the

the rachis shows here and there a very slight wing, like that of *P. stenoptera*, only never serrate in margin. The fruits have oval wings, shorter and broader than those of *P. stenoptera*, the nut being more beaked than in that species. The veining of the fruit-wings resembles *P. caucasica*.

DISTRIBUTION

Pterocarya caucasica has been found in the northern provinces (Astrabad and Ghilan) of Persia, and in Russian Armenia, as well as in the Caucasus. According to Radde,[1] it occurs in the marshy delta of the Rion in company with *Alnus glutinosa*, and along the coast of the Black Sea, mixed with oak, beech, and hornbeam. It grows sometimes as a tree, but oftener as a tall shrub, on the banks of streams. It extends up to about 1200 feet only in Kachetia, and is met with as far eastward as Talysch, on the coast of the Caspian Sea, where in damp places it forms the principal underwood. It is not found wild in the interval between the lower Rion on the west and the lower valley of the Alazan on the south side of the central Caucasus, and is again absent from here to the province of Talysch.

Mr. Younitsky of the Russian Forest Service has kindly sent me the following account of the tree in the Caucasus. He says it is only found in certain stations, rarely over 1200 feet elevation, and always in moist or very wet places, to which it is better adapted than even the alder. In the young stage the tree is very delicate and susceptible to spring frosts, requiring shelter when young; and when older does not bear shade well. Very large trees occur, of 100 feet in height and 10 feet in girth, and logs of it are obtained bare of branches for 50 feet, with a girth of 5 feet at the smaller end. It grows very rapidly in youth, making a height of 30 feet in ten years. The wood is light and soft, resembling much that of the lime-tree, and is chiefly used for making boxes and packing-cases. The bark is used for sandals and roofing. The leaves contain a poisonous matter, and when thrown into water intoxicate the fish, which rise to the surface and are easily caught. The tree is rarely cultivated, but is recommended for planting in the wettest situations, where it will thrive better than almost any other tree.

CULTIVATION

Pterocarya caucasica was introduced into France by the elder Michaux on his return from Persia in 1782. According to Bosc the first tree was planted at Versailles, others a little time after being planted about the Museum in Paris. According to Mouillefert,[2] there are still growing at the Trianon, Versailles, and at the Museum, Paris, two fine specimens which are probably original trees.[3] The tree flowered and produced fruit in 1826 in the park at Malesherbes, according to a note by Gay in the Kew Herbarium. There is a tree 80 feet high and 9 feet in girth in the Old Botanic Garden at Geneva, which was seen by Elwes in 1905.

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[1] Radde, *Pflanzenverbreitung in Kaukasusländern*, 109, 139, 159, 182, 205, etc.

[2] *Traité des Arbres*, ii. 1195 (1898).

[3] I could not find either of these trees in 1905.—H. J. E.

This species was introduced into England some time after 1800, the largest tree mentioned by Loudon in 1838 being one 25 feet high and fifteen years planted at Croome; but it is long since dead. (A. H.)

I have raised numerous plants of Pterocarya from seed sent me from the Caucasus by the late Dr. Radde in 1903, some of which was distributed by the Royal Horticultural Society. The seedlings grow fast, attaining 2 feet or more in height at two years old, but do not ripen their wood well when young, and are extremely liable to be injured by frost if not protected in spring.[1] The leaves appear about the same time as those of Liriodendron. The tree does not seem to dislike lime in the soil, and should be planted out when 3 or 4 feet high, in a situation where the ground is not liable to drought in summer, or near running water.

REMARKABLE TREES

This is one of the most ornamental hardwoods that we have; and is well worth planting in warm and sheltered positions in the south of England, where it thrives from Kent to Devonshire.

By far the largest and finest tree of this species known in England is at Melbury, Dorsetshire, the seat of the Earl of Ilchester. This magnificent tree (Plate 121) is growing on a sheltered bank below the house, on soil which contains lime, close to the finest specimen I know of *Picea Morinda.* It is no less than 90 feet high by 11 feet in girth, and has a straight clean bole about 15 feet long, spreading out into a symmetrical head of branches, and when I saw it in September 1906 had many catkins of fruit hanging on it.

Its spreading habit is shown by a fine tree at Claremont Park, near Esher, Surrey, which grows on deep sandy soil, and is a noble ornament of a lawn. The illustration of this tree (Plate 122) is from a photograph taken in 1903, when it measured about 50 feet in height, with a bole of only 4 feet high but no less than 18 feet in girth. It divides into eight large limbs, each of which is about 4 feet in girth, and the foliage spreads over an area of 30 yards in diameter. The tree is believed by Mr. Burrell, the gardener, to be about eighty years old, and seems to be decaying at the heart. The bark is very rough and deeply furrowed, and the leaves and flower-buds were just appearing, after a very mild winter, on 6th March. A self-sown seedling from it was about 2 feet high.[2]

Another fine tree is growing at Tortworth Court, from which I gathered ripe seed in October 1900, one of which grew in the following spring. The Earl of Ducie has raised several young trees from the same parent in other seasons. At Linton Park, Kent, there is a fine tree, which was about 50 feet high in September 1902, but not so large as the one at Claremont. Ripe fruiting specimens were sent from Devonshire by Sir John Walrond in 1888, which were figured by

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[1] The severe frost of 20th-22nd May 1905 seriously injured all my young trees, and it is evident that this tree should only be planted in situations where spring frosts are not severe.

[2] Mr. Burrell found a seedling in the summer of 1899. See *Garden*, 1902, lxii. 234, where a figure and description of the tree are given. See also *Garden*, 1894, xlv. 404, fig., and *Gard. Chron.* 1894, xvi. 192. According to a note in the Kew Herbarium, the Claremont tree was, in 1887, 45 feet high by 13½ feet in girth.

Dr. Masters in the *Gardeners' Chronicle*, but I have been unable to procure particulars of the tree from which the specimens were obtained.

In the Botanic Garden, Cambridge, there is an old tree which was 58 feet high in 1903, with eight stems, girthing from 3 feet to 4 feet 3 inches; and from the roots of another tree which was blown down about 1885 a number of strong stems, about twenty, have sprung up, which average about 50 feet in height and 2½ feet in girth. These particulars, which have been kindly sent me by Mr. Lynch, the curator, show the remarkable power of the tree in producing root-suckers (Plate 123).

A tree at Fota, near Queenstown in Ireland, seen by Henry in 1903, measured 42 feet high by 3 feet 9 inches in girth. It produced flowers and fruit in 1902.

Dr. Masters[1] recommends it for planting in towns, and says that there was a good specimen in the Chelsea Botanic Garden (since cut down) in 1891. There are said to be good specimens in some of the towns in Holland. (H. J. E.)

PTEROCARYA RHOIFOLIA

Pterocarya rhoifolia, Siebold et Zuccarini, *Abh. Bayr. Ak. Wiss. Math. Phys. Kl.* iv. 2, 141 (1845); Maximowicz, *Mél. Biol.* viii. 637 (1872); Shirasawa, *Icon. Ess. For. Japon.* text 35, t. 16 (1900).

Pterocarya sorbifolia, Siebold et Zuccarini, *loc. sit.*; Rehder, *Mitt. Dendrol. Deut. Gesell.* 1903, p. 115.

A tree attaining, according to Shirasawa, 100 feet in height, with a straight stem 10 feet in girth. Bark greyish brown with deep longitudinal fissures. Shoots glabrous. Leaves (Plate 125, fig. 3) 8 to 16 inches long, on a stalk about 2 inches long, which is swollen at its insertion; rachis without wings. Leaflets, fifteen to twenty-one, usually opposite, sessile or sub-sessile, 2½ to 5 inches long, oblong-lanceolate, acuminate at the apex, unequal at the base, which is rounded or somewhat narrowed; dark green above; under surface lighter green, with glandular scales, and some tomentum on the midrib and nerves and in their axils; somewhat thicker in texture than the leaves of *P. caucasica*; margin sharply and finely serrate.

Flowers appearing with the leaves. Staminate catkins two to three at the base of the young shoots; scale three-lobed, pubescent, bearing nine to twelve short-stalked stamens. Pistillate catkins, solitary, terminal at the end of the young shoot, later apparently lateral owing to the growth of the upper axillary bud. Fruiting catkins, 8 to 10 inches long; fruit an inch across; nut with a short, scarcely beaked apex; wings rhombic, broader than long, without any hollow at their base, inconspicuously veined.

The above description applies to the glabrous form, which is in cultivation in England and is common in Japan. In wild specimens from Yezo the leaves appear to be much more pubescent, the rachis and nerves being often covered with dense long hairs.

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[1] *Journ. R. Hort. Soc.* 1891, xiii. 86.

This species is readily distinguished by the peculiar buds, which are formed early, and by the scars at the base of the shoot, left by the fall of the bud-scales of the previous year. The buds at first are long, conical, with a curved beak, and are covered by a funnel-shaped membranous sheath, which is composed of two external and two to three internal glabrescent glandular scales. The scales fall off in November, leaving four or five narrow scars at the base of the buds, which in this stage resembles in structure those of *P. caucasica*, but are whitish and densely tomentose. Lateral buds usually solitary at some distance above the leaf scars. Twigs quite glabrous, otherwise as in *P. caucasica.* (A. H.)

In Japan this is a large tree known as *Sawa gurumi*, which I saw in the central provinces of Hondo, where it grows to a height of 50 to 60 feet, old trees attaining a girth of 8 or 10 feet. It generally grows on the banks of streams in mixed forest, and did not seem to be very common or to be valued for its timber, though I got a specimen of the wood from the Government sawmills at Atera, which is now at Kew.

Sargent found it very abundant on the slopes of Mt. Hakkoda, in the north of Hondo, at 2500 to 4000 feet elevation, where it attains as much as 80 feet in height, being next to the beech the largest deciduous tree in the forest. It is a broad-topped tree with stout spreading branches, and when covered with its long hanging slender racemes of fruit, is very handsome. It is hardy at the Arnold Arboretum near Boston and produces seeds there.

Pterocarya rhoifolia is recorded by Diels[1] as having been collected by Von Rosthorn in the province of Szechuan in China.

It seems to have been introduced into cultivation by the Duke of Bedford, to whom seeds were sent from Japan in 1889. Young plants from some of this seed were raised at Kew in 1890; and these have now attained about 12 feet in height. They are the only specimens we have seen in England.

(H. J. E.)

PTEROCARYA STENOPTERA

Pterocarya stenoptera, C. de Candolle, *Ann. Sc. Nat.* sér. IV. xviii. 34 (1862); Lavallée, *Arb. Segrez. Icones*, 65, t. 19 (1885); Franchet, *Journ. de Bot.* 1898, p. 317.

A tree, 50 to 60 feet in height, with a girth of stem of 6 or 8 feet. Bark rough. Leaves (Plate 125, fig. 2) about a foot in length; rachis covered with bristles, slightly swollen at its insertion, and having on each side a conspicuous irregular membranous wing, occasionally slightly serrate in margin. Leaflets nine to twenty-five, opposite or alternate, terminal leaflet often wanting; coriaceous; under surface with a few scattered glands, and some pubescence on the midrib and nerves and in their axils; oblong or oblong-lanceolate; acute at the apex, unequal and rounded or narrowed at the base, finely and sharply serrate in margin, 3 to 5 inches long. Male catkins, arising as in *P. stenoptera*; scale glandular, four-lobed; stamens six to ten. Female catkins 8 inches long; bract minute, bracteoles oblong and longer than the style, perianth with four subulate lobes. Fruit: catkins a foot or more in length; nut with conic beak-like apex; wings linear-oblong and erect.

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[1] *Flora von Central China*, 274 (1901).

The above description applies to the form in cultivation, which is also common in the wild state. The species is, however, very variable as regards the amount of pubescence, the twigs being often glabrous and the leaf-rachis only slightly pubescent. In many wild specimens the wing of the rachis is very slight.

This species is readily distinguishable in summer by the winged rachis of the leaf. In winter the twigs are slender and covered with a rusty-red bristly pubescence; but in other respects resemble those of *P. caucasica*. The buds, more slender than in that species, but similar in structure and position, are greyish in colour.

This is a common tree in the central and southern provinces of China, extending in a slightly different form into Tonking.[1] It is usually met with in the plains and low hills, along rivers and water-courses; and never grows to be a large tree. It is recorded from near Moukden in Manchuria, where it was collected by James; but was probably only cultivated there. It is usually called *ma-liu*[2] by the Chinese; and is much planted in the streets of Shanghai, where it is often called "Chinese ash" by the European inhabitants. As the climate of the regions where it grows naturally is very different from that of England, it is liable to be injured by spring frosts, and fails from want of heat in autumn to ripen its wood. The timber is considered in China to be of little value.

The tree was introduced into Europe apparently by Lavallée, who received the seeds from Siebold, about 1860. It supported at Segrez very low temperatures in 1870 and 1871; but succumbed during the severe winter of 1879-1880. Lavallée considered it to be about as hardy as the common walnut.

The only specimen that we have seen in England of any size is at Tortworth, where Elwes measured in 1905 a tree 32 feet high by 2 feet 3 inches in girth, believed by Lord Ducie to have been planted about twenty years. It is in a shady and sheltered valley and produced small racemes of fruit in 1905. (A. H.)

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[1] *Var. tonkinensis*, Franchet, *Journ. de Bot.* 1898, p. 318. A geographical form, distinguished by large leaflets, up to 6 inches long, and linear wings to the fruit, which diverge at a wide angle.

[2] Henry, "Chinese Names of Plants," *Journ. China Branch R. Asiat. Soc.* xxii. 256 (1887).

CLADRASTIS

Cladrastis, Rafinesque, *Cincinnati Literary Gazette*, i. 66 (1824); and *Neogeniton*, i. (1825); Bentham et Hooker, *Gen. Pl.* i. 554 (1865).

Maackia, Ruprecht et Maximowicz, *Mél. Biol.* ii. 440, t. ii. (1856).

Deciduous trees or shrubs belonging to the division Papilionaceæ of the order Leguminosæ. Leaves alternate, unequally pinnate; leaflets opposite, sub-opposite or alternate, on stout petiolules, entire in margin, and without stipels. Flowers in panicles or racemes, on slender pedicels; calyx with four or five short unequal teeth; corolla papilionaceous, petals unguiculate, standard nearly orbicular, wing and keel-petals oblong; stamens ten, free or slightly united at the base; anthers versatile; ovary with numerous ovules; style incurved, subulate; stigma terminal, minute. Pod linear, flattened, thin, thickened on the upper margin; valves membranous; seeds four to six.

Four species of Cladrastis have been described, constituting two sections, which have been considered by Sargent and other botanists to form two distinct genera, Cladrastis and Maackia. The difference in the buds of the two sections is remarkable; but analogous differences occur in other genera, as Carya and Pterocarya; and in the absence of important differential characters in the flowers and fruit, it is advisable to unite the sections into one genus.

Section I. Eu-Cladrastis.

Buds several together, compressed into a cone, and concealed in the base of the petiole of the leaf. Leaflets usually alternate. Flowers in panicles; calyx five-toothed.

1. *Cladrastis tinctoria*, Rafinesque. Kentucky, Tennessee, Alabama, and N. Carolina.

Shoots glabrous. Leaflets seven to eleven, oval or ovate, acuminate, almost completely glabrous.

2. *Cladrastis sinensis*, Hemsley. Central and western China.

Shoots rusty pubescent towards the base. Leaflets nine to eleven, oblong-lanceolate, obtuse or sub-acute, rusty pubescent towards the base and along the midrib.

Section II. Maackia.

Buds solitary, axillary, not concealed. Leaflets opposite or sub-opposite. Flowers in racemes; calyx four- or five-toothed.

3. *Cladrastis amurensis*, Bentham et Hooker. Amurland, E. Manchuria, Korea, and Japan.

   Shoots pubescent. Leaflets nine to eleven; deltoid, ovate or oval; obtuse or acute; densely appressed pubescent; calyx four-toothed.

4. *Cladrastis Tashiroi*, Yatabe.[1] Loochoo Islands.[2]

   Allied[3] to *C. amurensis*, but always a small shrub; with smaller leaflets, acute and not truncate or rounded at the base as in that species, glaucescent and scarcely pubescent beneath. Flowers and pods also smaller; calyx five-toothed.

CLADRASTIS TINCTORIA, YELLOW-WOOD

Cladrastis tinctoria,[4] Rafinesque, *Neogeniton*, i. (1825); J. D. Hooker, *Bot. Mag.* t. 7767 (1901).

Cladrastis fragrans, Rafinesque (name only), *Cincinnati Literary Gazette*, i. 66 (1824).

Cladrastis lutea, Koch, *Dendrologie*, i. 6 (1869); Sargent, *Silva N. America*, iii. 57, tt. 119, 120 (1892), and *Trees N. America*, 568 (1905).

Virgilia lutea, Michaux, *Hist. Arb. L'Amér.* iii. 266, t. 3 (1813); Loudon, *Arb. et Frut. Brit.* ii. 565 (1838).

A tree attaining 60 feet in height, and rarely 12 feet in girth. Bark smooth and silvery grey. Branchlets brittle, glabrous. Leaves (Plate 125, fig. 5) alternate, unequally pinnate, 8 to 12 inches in length. Leaflets seven to nine, usually alternate; the terminal one largest, articulate and directed to one side, often broadly rhombic; the others gradually diminishing in size towards the base of the leaf, 3 to 4 inches long by 1½ to 2 inches wide, on stout pubescent petiolules, oval or ovate, entire and non-ciliate in margin; base broadly cuneate or rounded, apex acuminate; upper surface light green and glabrous; lower surface pale green with occasional hairs on the midrib and veins. Rachis of the leaf terete, glabrous, with the base swollen and hollowed out, enclosing the buds, which are usually four, the largest and uppermost one developing, the others minute and rudimentary.

Flowers in nodding terminal panicles, 10 to 20 inches long, white, with a yellow spot at the base of the standard. Pedicels slender and not grouped in pairs. Calyx canpanulate, enlarged on its upper side; teeth five, short, obtuse, nearly equal. Corolla papilionaceous with clawed petals; standard nearly orbicular; wings oblong and two-auricled at the base; keel-petals free, oblong, and sub-cordate or two-auricled at the base. Stamens ten, free. Ovary linear, stalked, villose; ovules numerous. Pod glabrous, short-stalked, linear, glabrous. Seeds four to six, attached by slender stalklets, oblong-compressed, without albumen.

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[1] *Tokyo Bot. Mag.* vi. 345, t. 10 (1892).

[2] Cf. Ito and Matsumura, *Journ. Science College, Imp. Univ. Tokyo*, xii. 436 (1899).

[3] Judging from the description, as I have seen no specimens. There are specimens in the Kew Herbarium (*Cladrastis, sp.*? Hemsley, *Journ. Linn. Soc.* (*Bot.*) xxiii. 201 (1887)) which were collected by Millett, probably in the vicinity of Canton, which are very near to the Loochoo species.

[4] This name is adopted as being the first one with a description published under the correct genus.

SEEDLING

A plant, raised from seed sown at Colesborne on 2nd March, showed the following characters on 7th July:—Root white, fleshy, tapering, 3 inches long, giving off numerous lateral fibres. Caulicle striated, glabrous, 1½ inch long. Cotyledons two, sub-sessile, oblong, tapering slightly at the base, broader towards the rounded apex; green above, white beneath, coriaceous, entire. Stem terete, with a few scattered hairs below, densely white pubescent above. Leaves, all with petioles swollen at the base; first pair opposite, on pubescent stalks, simple, ovate, entire, 2 inches long by 1½ inch broad. The third, fourth, and fifth leaves are alternate; the third simple and like the first pair; the fourth and fifth trifoliolate on a stalk 2 inches long, terminal leaflet ovate, lateral leaflets oval and smaller.

IDENTIFICATION

Cladrastis tinctoria is readily distinguishable in summer by the pinnate leaves with alternate leaflets, of which the terminal one is directed to one side of the leaf; and by the swollen base of the petiole, which encloses and conceals the buds.

In winter the following characters are available (Plate 126, fig. 4):—Twigs zigzag, shining, brown or grey, terete, glabrous; lenticels minute, numerous. Leaf-scars alternate, obliquely set on slightly prominent pulvini, oval, whitish, with five bundle-dots on the outer rim, the centre of the scar being occupied by a projecting cone, which consists of four buds compressed together and superposed one above the other, the uppermost one the largest, all pubescent. Terminal bud not formed, the apex of the twig showing a small circular scar or a short stump, indicating where the top of the branchlet fell off in early summer.

DISTRIBUTION

Cladrastis tinctoria is one of the rarest trees in the American forest, growing only in a few isolated localities in central Kentucky, central and eastern Tennessee, northern Alabama, and the south-western part of N. Carolina. It is met with on limestone ridges and cliffs, usually in rich soil, and frequently overhangs mountain streams. (A. H.)

CULTIVATION

The yellow-wood is a favourite ornamental tree in American gardens, where, according to Sargent,[1] it adapts itself readily to varied conditions of soil and climate, though it requires deep rich soil in order to attain its full size and beauty. It has a tendency, however, which in England is equally marked, to divide into several spreading stems, which are rather brittle and liable to split the trunk. Its long racemes of white fragrant flowers make it a very pretty tree early in June, but in our climate these are not produced as freely as in America, and I have never seen fruit ripened in this country. In autumn the leaves turn a bright yellow.

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[1] *Garden and Forest*, i. p. 92.

Sargent[1] gives an illustration of a beautiful specimen in a garden near Boston which, 35 years after planting, was 35 feet high and had a spread of nearly 60 feet. I saw several in this district, but none so large as those which I have seen in England.

Though it germinates quickly, and seems easy to raise from seed, the tree is now seldom planted in England, but may be recommended for warm sheltered situations in good soil in the south and east, though perhaps the damp climate of the west does not suit it; and as most of the trees mentioned by Loudon have disappeared, it seems to be short-lived in this country. The seedlings which I have raised from American seed are fairly hardy, and after the first two years grow better than many American trees on my soil.

This species was introduced into cultivation in England in 1812, by John Lyon, a Scotsman who travelled in Carolina, Georgia, and Florida.

REMARKABLE TREES

The largest tree known to us is at Syon (Plate 124), which in 1904 was no less than 60 feet in height by 7 feet in girth and still a fine tree, though its trunk is decaying inside. There is another in Kew Gardens, near the Director's office, which measures 35 feet high, with a bole of 3 feet girthing 5 feet 4 inches and dividing into six main stems, which sub-divide into numerous upright branches. At the Knaphill Nursery near Woking is a very well grown tree about 45 feet high and 8 feet in girth, the head spreading to 16 yards in diameter.

At Highclere there is a tree which measures 42 feet by 7 feet with a spread of branches of 45 feet. Although there is some decay near the root the tree seems to have become more vigorous recently. At Blenheim there is an old specimen, with a stem divided close to the ground, and forming rather a large bush than a tree. At Cornbury Park there is also a fair-sized tree. At Barton, Suffolk, a tree planted[2] in 1832 was in 1904 25 feet high with a short bole, 5 feet 6 inches in girth, dividing into three wide-spreading main branches.

We have not seen any large enough to mention in Scotland or Ireland.

TIMBER

The wood, according to Sargent, is heavy, hard, strong, and close-grained, and is susceptible of a fine polish. At one time it was used in Kentucky for making gun-stocks; but is too rare to have any commercial importance. It produces a yellow dye. (H. J. E.)

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[1] *Garden and Forest*, i. p. 92.

[2] Bunbury, *Arboretum Notes*, p. 1.

CLADRASTIS AMURENSIS

Cladrastis amurensis, Bentham et Hooker, *Gen. Pl.* i. 554 (1865); Maximowicz, *Mél. Biol.* ix. 72 (1873); Franchet et Savatier, *Enum. Pl. Jap.* i. 115 (1875) and ii. 327 (1879); J. D. Hooker, *Bot. Mag.* t. 6551 (1881); Shirasawa, *Icon. Ess. Forest. Jap.* text 85, pl. L. figs. 1-12 (1900).

Maackia amurensis, Ruprecht et Maximowicz, *Mél. Biol.* ii. 418, 441 (1856) and 534 (1857); Maximowicz, *Prim. Fl. Amur.* 87, 390, t. v. (1859); Morren, *Belgique Horticole*, 1890, p. 301, t. 18; *Gartenflora*, 1875, p. 152.

A small tree, attaining 40 or 50 feet in height, with bark peeling off in old trees like that of a birch. Young shoots minutely pubescent. Leaflets (Plate 125, fig. 6) seven to eleven, opposite or rarely sub-opposite, the terminal one articulate, the lateral ones on short, stout pubescent petiolules; 2 to 3 inches long; deltoid, ovate or oval; base truncate or rounded; apex obtuse or acute; entire; upper surface dark green and minutely pubescent; lower surface pale green, densely appressed pubescent; rachis pubescent, swollen at the base.

Flowers greenish white, on long pedicels, in simple or occasionally branched erect terminal dense racemes. Calyx teeth four, short, broad, unequal. Petal-claws long, slender; standard obovate, emarginate; wings oblong, obtuse, two-auricled at the base; keel petals partially coalesced, one-auricled. Stamens slightly connate below. Pod, 2 to 3 inches long, oblong, flattened, brown, slightly appressed pubescent; seeds, one to five, oblong.

In specimens from the Asiatic continent the leaflets are larger and much less pubescent than in the Japanese tree, which has been distinguished by Maximowicz as var. *Buergeri*,[1] and is characterised by very dense appressed pubescence on the lower surface of the leaflets and white tomentose shoots.

In winter the twigs (Plate 126, fig. 5) are shining, glabrous; leaf-scars on prominent pulvini, semicircular, marked by a central large tubercular bundle-scar and two minute dots close to the upper margin; true terminal bud absent, the top of the branchlet having fallen off in early summer and leaving a short stump at the apex of the twig. Buds solitary, dark brown, shining, pubescent towards the apex, showing two scales visible externally.

Cladrastis amurensis occurs in Amurland as far north as lat. 52° 20′, and grows throughout Eastern Manchuria and Korea, the largest tree seen by Maack being only 35 feet high and 1 foot in diameter. According to Shirasawa, it is met with in Japan on moist rich soils in the temperate parts, ascending to 4300 feet in the central chain of the main island, and attaining a height of 50 feet and a diameter of 28 inches. It was collected by Elwes in the forest near Asahigawa in central Hokkaido, where, however, it was not abundant or conspicuous. It is called *Inu-enju* in Japan.

Cladrastis amurensis was introduced from the Amur in 1864 by Maximowicz; and has been spread throughout Europe by the St. Petersburg Botanical Garden. It probably came into England about 1870.

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[1] *Mél. Biol.* ix. 72 (1873).

It is propagated either by seed or by root-cuttings. At Kew it is rather a shrub than a tree, and produces flowers when quite young, which appear late in the season, in the end of July or the beginning of August. It ripens its fruit in October, the pods remaining on the tree during winter.

The timber, according to Shirasawa, is hard and tenacious, and is used in building and in making furniture. Elwes purchased planks of it at Sapporo, which are of a yellowish-brown colour, and seem to be of good quality for cabinet-making.

(A. H.)

CLADRASTIS SINENSIS

Cladrastis sinensis, Hemsley, *Journ. Linn. Soc.* (*Bot.*) xxix. 304 (1892).

A tree attaining 70 feet in height and 10 feet in girth. Young shoots rusty pubescent towards the base. Leaflets nine to eleven, alternate, entire, oblong-lanceolate, obtuse or acute at the apex; broad and rounded, rarely cuneate, at the base; lower surface with appressed pubescence most marked towards the base and along the midrib. Leaf-rachis pubescent, with swollen base enclosing two or three buds. Leaf-scars on older shoots, oblique on prominent pulvini, orbicular; the raised circular rim, discontinuous above, surrounding a central densely pubescent depression, in which lie two or three buds, the upper one of which is the largest.

Flowers pinkish-white, fragrant, in large terminal, rusty-pubescent panicles. Calyx rusty-pubescent; teeth short, broad, rounded. Petals long-clawed, erect, free; standard broadly obovate, bifid; wings and keel-petals oblong. Stamens slightly connate at the base; ovary pubescent. Pod linear-oblong, flattened, with thickened margins.

This tree, which resembles *Sophora japonica* in habit and foliage, was discovered by Pratt, in 1890, in Western Szechuan, where E. H. Wilson subsequently saw large trees at 7000 feet altitude in the Hsiang Ling range, west of Mt. Omei. It also occurs in the high mountains of the Fang district in Hupeh, from whence seeds were sent home by Wilson in 1901. Plants raised at Coombe Wood were, in 1906, 5 feet high, and for so far have proved perfectly hardy. The tree has beautiful flowers, and, growing at high altitudes in western China, should thrive in this country. (A. H.)

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